SEMICONDUCTORS: THE ROLE OF CONSORTIA

HEARING

BEFORE THE

SUBCOMMITTEE ON
TECHNOLOGY AND COMPETITIVENESS

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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SEMICONDUCTORS: THE ROLE OF CONSORTIA

TUESDAY, JULY 23, 1991

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS,
Washington, D.C.

The Subcommittee met, pursuant to notice, at 9:34 a.m. in room 2325, Rayburn House Office Building, Hon. George E. Brown, Jr. [acting Chairman of the Subcommittee] presiding.

Mr. BROWN. You can come to the table, Mr. Pickle, because we are going to call on you very shortly.

The Subcommittee will come to order and since we already have the cameras working, we will assume that they have been granted permission for coverage unless there is some objection. Hearing none, they will be approved.

Let me first say that Mr. Valentine, the Chairman of this Subcommittee, regrets very much that he couldn't be here this morning and he has asked me to serve temporarily in his place. He is busily engaged in the Public Works Committee in getting more highways for North Carolina and he thought that that was a very important role for him to be playing this morning. He also asked me to express his regrets to Dr. Sumney, from North Carolina, and indicate to him that he wasn't shunning him; he just had other things that he needed to do, so we hope that he'll be understood for that.

I have a brief opening statement. First of all, Mr. Valentine has a brief opening statement, and without objection that will be included in the record. I have a brief opening statement which probably says the same thing that Mr. Valentine's opening statement says. If it isn't too long I'll read a part of it—it doesn't seem to be too long.

The role of consortia in the semiconductor industry has sparked debate over how the United States can best compete in the global semiconductor marketplace. The concept of companies, which are normally intense competitors with one another, collaborating on research and development is considered unusual to many. However, the tremendous cost of research and development that is necessary to remain at the leading edge in the semiconductor industry has induced firms of all sizes to cooperate in the R&D stage of business.

I will not attempt to lay out all the costs and benefits of cooperative research, but the fact is that consortia are active overseas. In the United States, some of the largest corporations have indicated their willingness to cooperate at pre-competitive levels. However,

not everyone within the semiconductor industry believes that consortia are the saviors. Some fear that the entrepreneurial culture will abandon the industry if consortia become prevalent. Others fear that consortia may result in the growth of oligopolies which will stifle competition.

The technological effectiveness of past consortia can be debated in terms of original goals set forth. Some projects clearly fit better in the consortia model than others. The overall benefits go beyond the specific goals of consortia, however, to include the increased horizontal and vertical integration with the electronics industry. Customers could better inform suppliers of their problems and needs as well as influence the research to most effectively push the technological frontier forward.

Government involvement in consortia is also at issue today. The National Cooperative Research Act gave companies the opportunity to form research partnerships on their own. Consortia could undertake projects utilizing Government funds on an individually evaluated basis. The addition of Government funds to consortia has led to questions as to the most effective way to spend Government research dollars. In addition, we need a better understanding of the conditions that warrant Government participation in the semiconductor industry's research. We need to know if the Federal Government should follow the Japanese model of targeting specific industries and coordinating an effort to become the leader in that industry.

And finally, the structure of consortia in the 1990s is a question of concern. Should research done in consortia be done in lieu of or parallel to a company's own research efforts? How can the technology best be disseminated to member companies and how is membership determined? Our distinguished panel of witnesses will address these questions as well as present their expert opinions on what must be cone to revitalize the U.S. semiconductor industry.

[The prepared statements of Mr. Brown and Mr. Valentine follow:]

OPENING STATEMENT

OF

THE HONORABLE GEORGE E. BROWN, JR.

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS

HEARING ON

SEMICONDUCTORS: THE ROLE OF CONSORTIA

July 23, 1991

THE ROLE OF CONSORTIA IN THE SEMICONDUCTOR INDUSTRY HAS SPARKED DEBATE OVER HOW THE UNITED STATES CAN BEST COMPETE IN THE GLOBAL SEMICONDUCTOR MARKETPLACE. THE CONCEPT OF COMPANIES, WHICH ARE NORMALLY INTENSE COMPETITORS WITH ONE ANOTHER, COLLABORATING ON RESEARCH AND DEVELOPMENT IS CONSIDERED UNUSUAL TO MANY. HOWEVER, THE TREMENDOUS COST OF RESEARCH AND DEVELOPMENT THAT IS NECESSARY TO REMAIN AT THE LEADING EDGE IN THE SEMICONDUCTOR INDUSTRY HAS INDUCED FIRMS OF ALL SIZES TO COOPERATE IN THE R&D STAGE OF BUSINESS.

I WILL NOT ATTEMPT TO LAY OUT ALL THE COSTS AND BENEFITS OF COOPERATIVE RESEARCH, BUT THE FACT IS THAT CONSORTIA ARE ACTIVE OVERSEAS. IN THE UNITED STATES, SOME OF THE LARGEST CORPORATIONS HAVE INDICATED THEIR WILLINGNESS TO COOPERATE AT PRE-COMPETITIVE LEVELS. HOWEVER, NOT EVERYONE WITHIN THE SEMICONDUCTOR INDUSTRY BELIEVES THAT CONSORTIA ARE THE SAVIORS. SOME FEAR THAT THE ENTREPRENEURIAL CULTURE WILL ABANDON THE INDUSTRY IF CONSORTIA BECOME PREVALENT. OTHERS FEAR THAT CONSORTIA MAY RESULT IN THE GROWTH OF OLIGOPOLIES WHICH WILL STIFLE COMPETITION.

THE TECHNOLOGICAL EFFECTIVENESS OF PAST CONSORTIA CAN BE DEBATED IN TERMS OF ORIGINAL GOALS SET FORTH. SOME PROJECTS CLEARLY FIT BETTER IN THE CONSORTIA MODEL THAN OTHERS. THE OVERALL BENEFITS GO BEYOND THE SPECIFIC GOALS OF CONSORTIA, HOWEVER, TO INCLUDE THE INCREASED HORIZONTAL AND VERTICAL INTEGRATION WITHIN THE ELECTRONICS INDUSTRY. CUSTOMERS COULD BETTER INFORM SUPPLIERS OF THEIR PROBLEMS AND NEEDS AS WELL AS INFLUENCE THE RESEARCH TO MOST EFFECTIVELY PUSH THE TECHNOLOGICAL FRONTIER FORWARD.

GOVERNMENT INVOLVEMENT IN CONSORTIA IS ALSO AT ISSUE TODAY. THE NATIONAL COOPERATIVE RESEARCH ACT GAVE COMPANIES THE OPPORTUNITY TO FORM RESEARCH PARTNERSHIPS ON THEIR OWN. CONSORTIA COULD UNDERTAKE PROJECTS UTILIZING GOVERNMENT FUNDS ON AN INDIVIDUALLY EVALUATED BASIS. THE ADDITION OF GOVERNMENT FUNDS TO CONSORTIA HAS LED TO QUESTIONS AS TO THE MOST EFFECTIVE WAY TO SPEND GOVERNMENT RESEARCH DOLLARS. IN ADDITION, WE NEED A BETTER UNDERSTANDING OF THE CONDITIONS THAT WARRANT GOVERNMENT PARTICIPATION IN THE SEMICONDUCTOR INDUSTRY'S RESEARCH. WE NEED TO KNOW IF THE THE FEDERAL GOVERNMENT SHOULD FOLLOW THE JAPANESE MODEL OF TARGETTING SPECIFIC INDUSTRIES AND COORDINATING AN EFFORT TO BECOME THE LEADER IN THAT INDUSTRY.

FINALLY, THE STRUCTURE OF CONSORTIA IN THE 1990s IS A QUESTION OF CONCERN. SHOULD RESEARCH DONE IN CONSORTIA BE DONE IN LIEU OF OR PARALLEL TO A COMPANY'S OWN RESEARCH EFFORTS? HOW CAN THE TECHNOLOGY BEST BE DISSEMINATED TO MEMBER COMPANIES AND HOW IS MEMBERSHIP DETERMINED? OUR DISTINGUISHED PANEL OF WITNESSES WILL ADDRESS THESE QUESTIONS AS WELL AS PRESENT THEIR EXPERT OPINIONS ON WHAT MUST BE DONE TO REVITALIZE THE U.S. SEMICONDUCTOR INDUSTRY.

THE HONORABLE TIM VALENTINE

CHAIRMAN, SUBCOMMITTEE ON TECHNOLOGY
AND COMPETITIVENESS

HEARING ON
SEMICONDUCTORS: THE ROLE OF CONSORTIA

OPENING STATEMENT

GOOD MORNING LADIES AND GENTLEMEN. OUR HEARING THIS MORNING CENTERS AROUND THE SEMICONDUCTOR INDUSTRY AND THE ROLE THAT CONSORTIA PLAY IN ENHANCING THE TECHNOLOGICAL AND ECONOMIC COMPETITIVENESS OF THE UNITED STATES SEMICONDUCTOR INDUSTRY. THE IMPORTANCE OF SEMICONDUCTORS AND THE SUPPORTING SEMICONDUCTOR MANUFACTURING EQUIPMENT HAS BEEN WELL DOCUMENTED AS AN AREA CRITICAL TO NUMEROUS OTHER INDUSTRIES, OUR NATIONAL DEFENSE, AND TO OUR NATION'S OVERALL ECONOMIC COMPETITIVENESS.

CONSORTIA HAVE BEEN PRESENTED AS ONE WAY FOR AMERICAN COMPANIES TO COUNTER INTENSE FOREIGN COMPETITION IN THE SEMICONDUCTOR INDUSTRY. AIDED BY THE PASSAGE OF THE NATIONAL COOPERATIVE RESEARCH ACT OF 1984, NUMEROUS CONSORTIA SUCH AS THE MICROELECTRONICS AND COMPUTER TECHNOLOGY CORPORATION (MCC), THE SEMICONDUCTOR RESEARCH CORPORATION (SRC), SEMATECH, AND U.S. MEMORIES EMERGED, MEETING WITH VARYING LEVELS OF SUCCESS.

JAPANESE CONSORTIA HAVE OFTEN SERVED AS MODELS OR MOTIVATION FOR CONSORTIA IN THE UNITED STATES. THEIR COOPERATION IN PROGRAMS LIKE THE VERY LARGE SCALE INTEGRATION PROJECT (VLSI) HAVE YIELDED PHENOMENAL RESULTS AND, IN SOME CASES, STIFLED COMPETITION FROM U.S. COMPANIES. THE UTILIZATION OF CONSORTIA IN JAPAN WILL ALSO BE DISCUSSED TODAY, AS WELL AS THE PROS AND CONS OF APPLYING SOME FORM OF THAT SYSTEM HERE AT HOME.

JOINT RESEARCH AND PRECOMPETITIVE TECHNOLOGICAL DEVELOPMENT WITHIN CONSORTIA CAN POTENTIALLY PROVIDE SUBSTANTIAL BENEFITS TO THE SEMICONDUCTOR INDUSTRY. IN ADDITION, JOINT VENTURES RELATE TO MANY OTHER ISSUES DISCUSSED BY THIS SUBCOMMITTEE. PROBLEMS ASSOCIATED WITH THE HIGH COST OF CAPITAL, DUPLICATION OF RESEARCH EFFORTS, AND A LACK OF LONG-TERM PLANNING COULD POSSIBLY BE SOLVED THROUGH CONSORTIA.

THERE ARE AREAS OF CONCERN,HOWEVER. CONSORTIA MUST ENSURE EFFECTIVE COOPERATION AMONG COMPANIES THAT ARE NORMALLY IN COMPETITION WITH ONE ANOTHER. THEY MUST ENSURE FAIRNESS OF OPPORTUNITY FROM RESEARCH SUPPORTED WITH GOVERNMENT FUNDS. CONSORTIA ALSO NEED A CLEAR PATH OF ACTIVITIES THAT WILL RESULT IN THE MAXIMUM BENEFIT FOR THE LARGEST POSSIBLE SEGMENT OF THE INDUSTRY.

COMING TO GRIPS WITH THE RAMIFICATIONS RESULTING FROM GOVERNMENT FUNDING OF AND ACTIVE PARTICIPATION IN THESE CONSORTIA IS INCREASINGLY IMPORTANT. CONGRESSIONAL RESPONSE TO THE MICROTECH 2000 INITIATIVE AND AND TO THE FORM OF SEMATECH II IS DRAWING NEAR. I AM LOOKING FORWARD TO THE IDEAS PRESENTED ON THESE AND OTHER ISSUES BY OUR DISTINGUISHED WITNESSES.

GIVEN THE IMPORTANCE OF THIS SUBJECT TO A BROAD SPECTRUM OF PEOPLE, I INVITE THOSE NOT FORMALLY APPEARING AS WITNESSES TODAY TO SUBMIT THEIR VIEWS FOR THE RECORD. THE RECORD WILL BE OPEN FOR TEN ADDITIONAL WORKING DAYS IF ANYONE WISHES TO SUBMIT TESTIMONY.

LET ME CONCLUDE BY EMPHASIZING THAT MANY COUNTRIES HAVE POLICIES AND PRACTICES, AS A COMPONENT OF NATIONAL ECONOMIC GROWTH STRATEGIES, THAT ARE DESIGNED TO SELECTIVELY PROMOTE TECHNOLOGICAL DEVELOPMENT AND ITS APPLICATION IN THE PRIVATE SECTOR. THE KEY TO IMPLEMENTING SUCH A POLICY IS THE ABILITY TO ADVANCE AN INDUSTRY WHILE MAINTAINING AND ENCOURAGING COMPETITION. THIS COMPETITION FURTHER STIMULATES INNOVATION, WHICH AGAIN STIMULATES COMPETITION IN A CONSTRUCTIVE, CYCLICAL FASHION. NOWHERE IS COMPETITION MORE INTENSE AND INNOVATION SO SWIFT AS IN THE SEMICONDUCTOR INDUSTRY. THERE IS NO QUESTION THAT THIS NATION MUST MAINTAIN A HEALTHY SEMICONDUCTOR INDUSTRY. THE QUESTION IS HOW DO WE MAINTAIN HEALTH, INNOVATION, AND COMPETITION TOGETHER.

Mr. BROWN. I'd be happy to introduce our distinguished Ranking Member, Mr. Lewis, for a statement at this time.

Mr. LEWIS. Thank you, Mr. Chairman, and it's good to see you back here in that chair again. Many don't know that you were here as Chairman in 1986 before you moved on to greater things.

Mr. BROWN. There's a lot of things that people don't know about me and it's just as well if they don't.

Mr. LEWIS. Well, that's good and that's why we won't express any more about that.

United States scientists conducted the basic research to develop and produce semiconductors and in 1974 the United States had almost 100 percent of the world production market in semiconductors. By 1988 the percentage had dropped to under 40 percent. In 1980 the top five U.S. semiconductor firms are spending $400 million annually on research. This was roughly equal to the research spending of the top five Japanese firms. By 1987 the top five Japanese firms were investing $2.4 billion annually in research and the top five U.S. firms, one-half that amount.

Also, in the 1980s is it alleged that Japanese corporations dumped underpriced semiconductors at a price below the cost to manufacture them on the United States market. This price war forced many American firms out of business. The U.S. response was to form in 1987 a joint Government-industry consortium with the goal of restoring our semiconductor competitiveness. The five year program has an annual budget of approximately $200 million dollars, one-half from Government and one-half from industry. The court consortium called Sematech has been credited with providing the spark that has stimulated both research and productivity in the semiconductor industry.

There are several questions that we hope to answer based on today's testimony. Two of them that I am concerned about are, is the Sematech Government-industry consortium the cost effective expenditure of taxpayers dollars? The other one is, is there a better alternative to Sematech type of consortia as a method of improving U.S. technology?

Mr. Chairman, I thank you very much for the opportunity to speak.

Mr. BROWN. Thank you very much for that statement, Mr. Lewis.

Ms. Horn, would you like to make an opening statement or could I just put it in the record?

Ms. HORN. Yes, Mr. Chairman, it can be put in the record, thank you very much.

Mr. BROWN. Thank you very much and without objection, Ms. Horn's full and eloquent statement will appear in the record at this point.

[The prepared statement of Ms. Horn follows.]

Opening Statement for Joan Kelly Horn
Before the Subcommittee on Technology and Competitiveness
July 23, 1991

Mr. Chairman, distinguished colleagues and witnesses, the topic of today's hearing, Semiconductors: The Role of Consortia, is important to the future competitiveness of our technology industries. Semiconductors have been listed on every "critical technologies" list published, including those of the Defense Department, the White House's OSTP, the Department of Commerce, and the U.S. Council on Competitiveness.

Since it is estimated that semiconductors will become a $150 billion industry by the year 2000, it is vital that we insure our competitiveness in so important an area. Approximately 2 to 3 million Americans are directly employed in the semiconductor industry. Furthermore, virtually every consumer product, from stereos to furniture, either depends on semiconductor components or will depend on semiconductor technology for their competitive manufacture. We do not want to lose any more manufacturing industries to overseas suppliers who have better manufacturing equipment based on state of the art semiconductor fabrication.

In addition, our defense industries are strongly dependent on critical high technology components. We must be sure that we retain the technology base necessary to manufacture all critical elements of our defense systems. Our national security and the independence of our foreign policy require it.

We must take whatever steps are necessary to insure our competitiveness in this industry. If forming consortia to compete with the Japanese MITI (Ministry of International Trade and Industry) and keiretsus (families of related industries) is necessary to allow a level playing field in the marketplace, we must consider a similar system. If additional government intervention is necessary, for example amending anti-trust legislation or tax laws, we must consider this. We can not permit our economy to suffer the consequences of allowing other nations to dominate this market. Nor can we permit ideology or inertia to prevent us from taking the steps necessary to insure our future competitiveness and economic health.

I look forward to hearing the testimony of our expert witnesses on how we can best restore the viability of our semiconductor industry. Some topics I would like to see addressed are how we can best help the smaller innovative companies compete with the international giants. Many new ideas and products are developed by entrepreneurs. In addition, I would like the witnesses' ideas on the steps government can take which would have the greatest impact on the semiconductor industry. Would forming additional consortia help most or would other steps be more effective? I look forward to hearing the witnesses' recommendations.

Mr. BROWN. Now, with that taken care of we are ready to hear from our distinguished colleague, Mr. Pickle, who has a deep and abiding interest in the subject matter at hand and in the general health of science technology in this country and we welcome him very much here.

STATEMENT OF HON. J.J. PICKLE, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. PICKLE. Thank you, Mr. Chairman, and I appreciate the chance to testify before this Committee. Years ago I was privileged to serve on this Committee and I remember the associations and I value the work that this Committee does.

Mr. Chairman, we were pleased to have you in Austin recently for the dedication of the University of Texas Research Center at Balcones. We are pleased at the work being carried on at that University and were happy to have you there and I hope other members have a chance to visit our facility.

Let me ask consent to provide this Chairman my remarks, Mr. Chairman, then I'll try to move along as quickly as I can.

Mr. BROWN. Without objection, it's okay.

Mr. PICKLE. I'm pleased to appear here today about the role which consortia or consortium—I always get mixed up on those—can play in enhancing the competitive position of the semiconductor industry. The reason I say that is because I have two of those industries in my district, Sematech—and you'll be hearing from Dr. Spencer here this morning, who is head of the Sematech group—and the MCC, Microelectronics and Computer Technology Corporation. Now, they're important to my district, but those two consortiums are, I think, extremely valuable for the United States. They are probably two principal examples of consortium at work. We have learned a lot from those two successful operations.

My challenge today is simply to say that we need to develop a comprehensive high tech policy. I think we all agree to that. The problem is, what is a high tech policy and how do we go about establishing it and get down to some practical approaches? I guess I will be a little negative to begin with by saying that we need to develop a high tech policy. And what I mean by that is we have got to stop talking past each other when we discuss high tech policy.

Different segments of the high tech industry occasionally argue among themselves about the proper role towards our competitors. Some academics say that we should imitate Japan's greater concentration among firms. Others say that pure competition is the only way to go. Republicans criticize any discussion of industrial policy as central economic planning. Democrats invite criticism by not being clear about their vision of industrial policy. I'm staying away from that general subject today because I don't think it is critical to the overall discussion that we are having.

Now to move beyond the unproductive dialogue, I believe that policy makers must come to a common understanding about our economy and how our economy is changed. We need to do three main things, as I see it: One, we need to develop a better understanding of what we are trying to achieve, we've got to have financial capital, we've got to have talent for the people performing the

work, we've got to have organization in order to produce quality products.

Now one issue that I want to emphasize today is that there seems to be a consensus about the need for cheaper capital and better trained workers and there is some agreement on the need for better organization of business. But there is little agreement on how, or even whether, Government should play a role in helping business better organize for the challenges of a global economy. We have not been able to really define the role that Government should play and I think that's terribly important. In my view, even if we make capital available for industry and if we turn out more and better trained workers, we may not be doing all we can to remove—to improve our economic and competitive competition. Now the issue of organization may be the toughest thing for us to do. How can business and Government work together? Years ago our economy could operate in cut-throat competition primarily based on price, all we had to do is produce a better hammer. That wasn't hard to do but we—all we had to do was produce a cheap one. What we have got to do now is produce high quality tools. That's the key to our survival for our economy.

Now, more specifically, the semiconductor chip, for example, is only as good as the equipment used to make it. A competitive semiconductor industry therefore depends on a competitive semiconductor equipment industry. That means both producers of the chip and the suppliers of the producers' manufacturing equipment must learn about each other' needs. As this Subcommittee knows, that is why Sematech was formed. Now, I realize Sematech is only one example, but we all need to recognize that the interdependence of different business sectors means that policy must respond. We need to use Government as a catalyst to make sure that business better cooperates with business and with industry and with Government. Now MCC, which I know has been the subject of some analysis, has refocused its mission towards solving specific problems for its members. Under the leadership of Craig Fields, who is formerly the head of the DARPA organization—in the Defense Department—MCC has embarked on a global digital network to link homes, schools, and businesses with the latest information technology.

Now I am not enough of a scientist to know exactly how they are going to do that but they are trying to be practical, they are trying to tie together business, and industry, the public and then American homes. And that's a goal that I think we must have to do.

Now, let me get my last point in. I think that we need to have some kind of consortiums to advance this work. I give you my two examples, the MCC and Sematech, and they have already proven that they are a valuable resources. The members who are part of Sematech, those companies—14 or 15 companies—work together. They are large companies, they are small companies, they share common knowledge. They do not let cut-throat competition get into the way of trying to find better ways to produce and to share that information with each other. They still go ahead and manufacture their own products but it's a means for industry to talk together and work together. Now I submit to you that that's terribly important. We could go it alone but if we didn't have Sematech or MCC

or the industrial triangle in North Carolina or the SRC, I think we'd be hard put—we'd be literally going at it by ourselves.

So I appeal to this Committee to say that we ought to form consortiums. I think the biggest problem we've got, Mr. Chairman, is that we do not know or we have not defined the role that Government should play in these consortiums. It seems to me the most important thing we have to do today is for our Federal Government to just say, yes, we've got a policy, the Government will play a part. We can argue a little bit about in what way and what role, and you and I might differ a little bit. But we've reached a point in this international competitiveness that somehow we have to tie in with the Government. Now that doesn't mean that we are going to guarantee a certain percentage of funding but we're not going to make any consortium successful unless you bring in Government.

I think there is no more greater need than for this Congress to simply say that our Federal Government announces that consortia are a legal acknowledgement, admission, on our part—it is our policy and we go on from there. I hope we don't get strangled on industrial policy or the winners and the losers and that type of argument that we all can disagree on perhaps, but if we can just come together and say that the Government will play a part. To me that's the most important thing that this committee can do. I've lived with this now for five years in my district. We're very proud of what Sematech is doing and I simply hope this Committee will advance that proposition and see if we can't work together. We've got to be partners in this whole operation.

Now, Mr. Chairman, I'd be happy to try to answer any questions that anybody might have but I appreciate very much your willingness to let me appear before this committee and make a statement.

[The prepared statement of Mr. Pickle follows.]

DRAFT

Testimony of Congressman Jake Pickle On
Semiconductors: The Role of Consortia
Before the Subcommittee on Technology and Competitiveness
July 23, 1991

I appreciate the opportunity to appear before the Subcommittee today to discuss the role which consortia can play in enhancing the competitive position of the semiconductor industry. As Members may be aware, two consortia of great importance to the electronics industry are in my District: SEMATECH and MCC -- the Microelectronics and Computer Technology Corporation. While these two consortia are important to my district, I strongly support SEMATECH and MCC because their work benefits the nation as a whole. Consortia can and have already made advances on the competitiveness front.

Today I want to issue a challenge to all of us -- Congress, the Administration, and the panelists testifying -- to roll up our sleeves and develop a comprehensive high-technology policy. Members of this Subcommittee and today's panelists can be keys to this process. It is my belief that consortia must play a part in whatever high-technology policy that Congress adopts.

Let me be more specific in the challenge we must meet to develop a high-tech policy: we -- and by that I mean those of us in government and business -- must stop talking past each other when we discuss high-tech policy. Different segments of the high-tech industry occasionally argue among themselves about the proper policy toward our competitors. Some academics say we should imitate Japan's greater concentration among firms, while others say pure competition is the only way to go. Republicans criticize any discussion of industrial policy as central economic planning. Democrats to some extent invite criticism by not being clear about their vision of industrial policy. I don't believe that this sort of discussion is very productive. All that is accomplished is that we know who is for some things, and who is opposed to other things. We don't get much done on making policy.

To move beyond this unproductive dialogue, I believe that policymakers must come to a common understanding about how our economy has changed. In spite of all the articles, speeches, and books on the global economy, I believe we must do more to understand fully how the changes in our economy require changes in policy.

Now, what do I mean when I say we need a better common understanding of the changes to our economy? When I talk to these business and academic leaders, I am most often told that the changes in our economy have greatly increased the demand for three things:

1) Financial capital -- high-tech industry is driven by investment in expensive research and specialized equipment. The cost of capital in America seems to rise as the changing structure of our economy calls for the availability of cheap capital. Our economy cannot tolerate such a pattern. For this reason, I am a supporter of a permanent research and development tax credit, a reduction in the capital gains tax rate in order to stimulate venture capital, and deficit reduction.

2) Talent -- industry needs well-trained individuals to stay ahead of the competition. Workers must come out of schools well-trained and able to continue to learn as competitive challenges arise. For that reason, I support efforts -- many of which originate in this Committee -- to improve this country's scientific literacy.

3) Organization -- business and government must do a better job at organizing for quality. That is where consortia can play a role. I firmly believe that the consortia can be most beneficial in helping business and government organize for quality.

The third issue is the one on which I want to dwell a little today. There seems to be a consensus about the need for cheaper capital and better trained workers. And there is some agreement on the need for better organization in business. But there is little agreement on how, or even whether, government should play a role in helping business better organize for the challenges of a global economy. Even if we make cheaper capital and better trained workers available to industry, we may not substantially improve our competitive situation. If business and government are not organized correctly, then we cannot take full advantage of cheaper capital and better education.

The issue of organization may be the toughest thing for policy-makers to address. It may also be the most important issue for this nation to address to compete successfully in a global economy. It seems to me that the more complex our products become, the more different parts of the production process are dependent on one another. Years ago, our economy could operate in cut-throat competition based on price. The trick wasn't to produce a high quality hammer (anyone could do that), but a cheap one. But today high quality tools are the key to survival for our economy. The quality of what one industry produces has a direct effect on the quality of product another industry can produce. The problem is that business and government, to a large degree, remain organized around an economy based on price, and not enough on quality.

The semiconductor chip, for example, is only as good as the equipment used to make it. A competitive semiconductor industry, therefore, depends on a competitive semiconductor equipment industry. That means both the producers of the chip and the suppliers of the producers' manufacturing equipment must learn about each other's needs. As this Subcommittee knows, that is why SEMATECH was formed. Now, I realize SEMATECH is only one example, but we all need to recognize that the interdependence of different business sectors means that policy must respond. We need to use government as a catalyst to make sure that business better cooperates with business to solve competitive problems. And I believe that SEMATECH is a good model for one part of a government high-technology policy, namely stimulating the growth of consortia to solve specific problems for industry.

MCC, which I know has been the target of some criticism, has refocused its mission toward solving specific problems for its member companies. Under the leadership of Craig Fields, former DARPA head, MCC has embarked on a "global digital network" to link homes, schools, and businesses with the latest information technology. Now I am not enough of a scientist to understand the technology involved, but I do know that a high-tech economy requires constant learning and

improvement of skills. Note that the goal of MCC here is to facilitate an improvement in quality -- the quality of the information network, the quality of our workforce.

The experience of SEMATECH and MCC suggests to me that consortia may be best at enabling different industries organize to tackle specific problems relating to quality -- whether the problem is semiconductor manufacturing equipment or the need for a global information network. Semiconductor producers and semiconductor equipment manufacturers must constantly update each other on their needs in order to produce a high quality chip. Thus we have SEMATECH as a focal point for exchange of information. Telecommunications companies and computer firms must work together to develop a high quality global communications network. Therefore, member companies turn to MCC for the "global digital network" project.

But consortia must be given time to work. It is unrealistic to expect consortia to produce the magic solution to our economic ills. Organizing for quality cannot occur instantly, or even in a few years. Obviously consortia must produce results -- as SEMATECH and MCC do -- but consortia are also about changing the way business organizes to solve problems. This is a dramatic change for U.S. industry and cannot be accomplished over night. American consortia need a stable operating environment. For these reasons, and because of the results it has produced, it is vitally important that SEMATECH be extended once its five year charter expires. Similarly, government should explore how it can contribute to the operating stability of other consortia, like MCC.

As a government, we must be involved in helping the private sector meet the challenges of solving the problems posed by our changing economy. That does not mean that government needs to pick winners and losers. Indeed government does not need to be in the lead in developing new technologies; business should do that. But government can facilitate the establishment of consortia to work on problems identified by industry and that may cross over from one industry to another. That is not picking winners, but instead helping industry solve technology problems that the marketplace has identified. This general approach is just plain common sense, and it is frequently employed by our competitors. This country cannot waste much more time debating these issues, and not working on solving problems.

I realize that I have ventured into areas in which I am not a specialist. But I feel that the subjects I have touched upon, and certainly others, are issues we must confront if we are to do something meaningful for our economic future. I am willing to join with this Committee, with the Ways and Means Committee on which I serve, industry, and experts, in developing a comprehensive high-tech policy. The more our debate about technology policy is based on labels, the more short-sighted it becomes. It's almost as if, when we try to find some vision of our future technology policy, we are looking through the wrong end of the telescope. What we see is near, it is very small, and we miss completely what we are searching for out in the distance. It is high time that we begin to put aside our differences, and turn the telescope around. We may not find future economic security immediately, but we stand a better chance of finding a vision for a rising standard of living for ourselves and future generations.

Mr. BROWN. Thank you very much, Mr. Pickle. Despite your disclaimer of expertise in this area, there is really no substitute for the common sense that you have expressed and we appreciate it very much. There are very few of us in Congress who are really experts on any of the technical areas that we are called on to deal with and sometimes we forget that that doesn't relieve us of the responsibility to use common sense in solving the problems that are concerned and you have demonstrated that very well here.

Do any of the members have any questions for Mr. Pickle?

Mr. Lewis?

Mr. LEWIS. Well, Mr. Chairman, first I'd like to thank the gentleman for his testimony. I always look forward to the wisdom of Mr. Pickle, the gentleman from Texas, but two things I want to bring forth.

One, apparently Sematech has done a good job and shown there can be some cohesiveness between the Government and the private sector in working toward a common goal, but in recent years the private sector has become very distrustful of Government applications. First they are told one thing and when you start off and they start merrily down the pike and then the next year everything is cut back or changed. How do we overcome this particular problem?

Mr. PICKLE. I'm sure as I don't know that we'll ever overcome it but perhaps we've done the right thing at Sematech. We originated Sematech but it was on a five year basis and now this is the fifth year. We have stayed together, the appropriation has been equal, 50 percent from Government, 50 percent from industries, a $100 million each. Now, that gave us a full five year program where we wouldn't disagree and then separate or be full of distrust. I think if we could start a program and give them a reasonable chance to stay together that would help. I think there would be more distrust if there was no talking among the companies. The companies have learned now, large and small, that we need to share common knowledge if we are going to be competitive on an international basis.

Now to come together in some sort of consortium I think is the best way to do away with the distrust which naturally is there because each company wants to make a profit and they don't want to share their secrets. But if they could share fundamental information, that's the best way to break down distrust.

Mr. LEWIS. One final question, one of today's witnesses makes a suggestion that in order for the United States to be more competitive in the semiconductor industry is to make permanent the R&D tax credit. How do you feel about that?

Mr. PICKLE. Oh yes. I feel very strongly that the R&D credit ought to be made permanent and I have a feeling, Mr. Lewis, we may do it this year if nothing more than for the fact that the people want it, the Members want it. There is a general agreement that we ought to have it—R&D. We have continued them now year after year after year but we wait to the last minute and, business then gets wary of the question of whether there will be R&D tax credit or not and therefore they won't make these long term investments.

Now, if we could make it permanent, then companies would know that the funding is there, the program is there and they

could make some long range planning. What we've done is good, we've kept R&D alive and I've helped take the lead in that to the extent possible on the Ways and Means Committee. But we've got that problem before us. It's going to run out now about September of this year. We need to make it permanent.

And, Mr. Lewis, I think we need to adjust our capital gain, I think we need to recognize that we could use that approach also. We can't make any better, bigger investment than we do in permanent R&D. I hope the Congress will finally do it. We all are going to vote for it, we just ought to say it publicly, it is permanent and then we go about our business instead of just wrestling with it year after year and accomplishing nothing or not as much as we could.

Mr. LEWIS. All right, I thank the gentleman for his testimony and his excellent answer.

Mr. PICKLE. Thank you.

Mr. BROWN. Did you hear what you wanted to hear Mr. Lewis?

Ms. Horn?

Ms. HORN. I have no questions of the Congressman. I'm very proud that I have both a nephew living in his district as well as a son who went to U.T.-Austin so I have very fond memories. In fact, my son was there at the time MCC was getting started. To sort of contradict myself though perhaps, Congressman, could you briefly say how you see MCC? It's not — it's a different sort of thing than Sematech. Does it look like now with a new director that it's kind of going the right direction?

Mr. PICKLE. Sematech is 50 percent financed by the Government, 50 percent financed by industry, MCC, for the most part is just consortium of 20 or more companies and it is not Government financed. Originally MCC had no Government participation at all. They were just sharing information with the companies. We're—MCC—is beginning to have some coordination with the Government. But the two entities are a little different operation. One is a sharing completely, the other is just private enterprises who come together to share common knowledge.

Ms. HORN. And have the companies stayed together that started out with MCC? Have there been companies in and out or —

Mr. PICKLE. By and large. Essentially the main companies have remained in it. There's a little dropping off one year and a little addition over here. There's been some change in and out but the numbers have essentially been the same. But I submit to you this is one of the problems we are going to have to face.

Now, let's take MCC for example, or any consortium we have in the country, one company gets in a financial condition that they say they may have to drop off, or some company— one company would say if you produce that product, that's going to hurt my company and I don't want to stay in this organization if you are going to do that. That is inevitable and the smaller a company is, sometimes that will mean that it will drop off.

Rather than, have that ebb and flow, ebb and flow, if we had some kind of a Federal policy that allowed them to come together and stay together on a more permanent basis with some Government participation, I think then you'd have less dropping off.

But to answer your question, in the general picture the companies have stayed together. I understand that yesterday or the day

before, the semiconductor people met—board of directors—and out of these 14 or 15 companies—every one of them was there—and they unanimously voted to embark on Sematech II and stay together the next five years to advance this work. So the companies are willing to put in their money and that's the key to consortium.

Ms. HORN. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Rohrabacher?

Mr. ROHRABACHER. Mr. Pickle, congratulations.

Mr. PICKLE. Thank you.

Mr. ROHRABACHER. I also echo the Chairman's praise of your common sense approach.

Now, the Japanese get their companies together and they say we are going to subsidize you, we're going to protect you, and we want to work together with you and we expect you to work together to beat the Americans and our Government seems to be sending the message, we're going to tax you, we're going to regulate you, and if you even speak together you're in violation of the anti-trust laws. I mean that's the bottom line of the competition between the United States and Japan. I mean we're trying to do everything we can to treat our companies as if they are milk cows and the Japanese are treating their companies like they are sacred cows and I think if we are going to be able to compete with the Japanese in high tech, we are going to have to change our attitude.

I think that what you are expressing today is a fundamental change in attitude—as you mentioned the capital gains tax and making permanent the R&D tax credit. These are things that are going to help our companies in international competition. Unfortunately I think in the past Government, especially the Federal Government, has too often been the enemy of our corporations rather than someone who realized that our corporations are so important to our overall national well being. Maybe you could comment on that?

Mr. PICKLE. Mr. Rohrabacher, the Japanese have—their government has gotten behind their companies and pushed them forward—given them the resources and they have given them the support. We haven't because we've always chosen to go it alone, let free enterprise operate by itself and it can. But in this day and time, I submit that we better form better partnerships on the Federal level. The Federal Government ought to have a role in this. We ought to say what it is, as best we can, and then get on with the business to help patching it together instead of just arguing about anti-trust and other arguments. If we are going to be competitive on an international basis, I think we've got to do just what you said and I hope that the Congress will do that and we can come together as a group to advance it. That's not being specialized or helping big companies, that's just being competitive, that's surviving.

Mr. ROHRABACHER. Thank you very much, Mr. Pickle.

Mr. BROWN. Thank you, Mr. Rohrabacher.

Let me just offer a comment or two, Mr. Pickle. The importance of this hearing is going to be educating the members as to the wide range of possibilities that we might have to select from in taking what you describe is a common sense approach to this problem. Our fundamental goal is to help American industry be more effi-

cient, more competitive, more profitable, and to help enhance the quality of life for the American people.

Now, within that framework there are a number of numerous ways which are illustrated in part by the Sematech/MCC difference. One is devoted to a specific subject as half Government financing, the other has a little broader mandate and no Government funding. There are models of variations that could be done here. There are models which are developing in connecting with the question of improving quality in which a major firm seeks to associate itself with its suppliers as a way to enhance the quality of the product that they supply to the major firms. That could be considered a consortia of sorts and there could be many different variations in that.

Or there could be a consortium just of small firms which have the peculiar problems that stem from their both their smallness and the nature of the product that they manufacture. We don't have any guidelines as to what is the best way to do it and I would ask for you to think this through a little bit yourself. Sematech, half Government funding, what's the reason for that?

Mr. PICKLE. Originally Sematech, the Defense Department was vitally concerned that chips are being manufactured with more efficiency by foreign governments and ships run all of our instruments and defense—

Mr. BROWN. Exactly.

Mr. PICKLE.—and if we were to depend entirely on chips we were depending on some other country's chips running our defense equipment and the Defense Department said, we'd better get more competitive and work together. So that's when DARPA, thank goodness, came in and said, we will join hands with industry to advance these programs.

Mr. BROWN. Well, we need the record to clearly reflect that and I am sure some of the witnesses will reflect that but in the case of Sematech the Government is a major customer and we cannot for security reasons allow ourselves to be confined to suppliers who are offshore. And that constitutes a very convincing reason why the Government should participate in enhancing our capability in this field. Now does MCC meet this same criteria or does it not? In looking at the underlying reason for a Government role, we need to apply them to each situation and see if we can justify a particular course of action here. And what I'm hoping this hearing will elucidate is what are the underlying factors which we can use to make judgments on some of these important questions.

Go ahead.

Mr. PICKLE. Well, I'll make one last appeal.

This Committee can do more to advance our policy—the Federal Government's—than any committee on the Hill. You've got the expertise here, you know more about the subject matter. My committee, the Ways and Means, can help make this R&D credit permanent, the Judiciary Committee can get off the dime and quit squabbling too much about anti-competitiveness, if they would, and most of all the Commerce Department has got to be a part of this and has got to put up some money. They can't keep saying, oh, we ought to have this over in our department, and not put up a dollar. That was the case five years ago. Commerce has got to enter into it

if we are going to get into such things, say, as high definition TV. It seems to me like it's terribly important that this particular committee now can advance the policy and the rest of our committees ought to be able to come in and dovetail and advance it.

Mr. BROWN. If this Committee comes to the conclusion that a reduction in the capital gains tax or a permanent R&D incentive tax are not perfect solutions and we wanted to convey that to your Committee, could we do that?

Mr. PICKLE. I'd be happy to take your letter and personally deliver it to my Chairman and I would invite you to go with me. I don't know what his response is—but I would say that I don't think that my Committee or my Chairman would oppose the proposition if taken on in terms of the budget and how it fits into the overall picture but we ought to brush those things aside and establish our policy if we think that's right.

Mr. BROWN. Well, I support a permanent R&D tax credit myself but as you know it does not benefit equally all firms, it depends upon the relative investment status and profitability of those firms as to how much benefit they get from it. Similarly, a reduction in the capital gains tax does not necessarily insure that there will be additional funds for R&D. If the firms wish to spend that money that they get as a result of the reduced taxes on something else, they can do so and we don't necessarily therefore benefit.

Mr. PICKLE. Thank you, Mr. Chairman. Thanks to the committee.

Mr. BROWN. Now we have a situation where we'd like to call up the next panel which is rather large, 1, 2, 3, 4, 5 people, so we'll invite them all to come up. They're going to have to be rather close together so we hope they are all friends and that they all have—whatever we need to do we'll do. We're going to be flexible here.

All right, we now have a bigger table. You can spread out a little bit.

Now, we're going to ask each of you to make a presentation. You've all submitted, I think, written statements. You may read that or abridge it, we're not going to be too strict on time but we're going to allow somewhere between half an hour and 45 minutes for your statements and then we'll like to have some time to question each other. We're going to ask you to speak in the order on which you are listed on the schedule and that is Dr. Sumney, Dr. Rodgers, Mr. Nishi, the other Mr. Rogers, Jerry Rogers; and then Dr. Spencer. If I have insulted any of you by calling you Doctor, you can correct me later. The camera is all ready, sound all ready, you may fire, Dr. Sumney.

STATEMENT OF LARRY SUMNEY, PRESIDENT AND CEO, SEMICONDUCTOR RESEARCH CORPORATION, RESEARCH TRIANGLE PARK, NORTH CAROLINA

Mr. SUMNEY. Mr. Chairman, Members of the Subcommittee, my name is Larry Sumney and I am President and Chief Executive Officer of the Semiconductor Research Corporation known throughout the industry and the academic community as the SRC. The SRC is a not-for-profit consortium established in 1982 that plans and executes a program of fundamental and applied research at our Nation's leading universities in areas of interest to the U.S.

semiconductor industry. It is the largest university driven research program in the country. We appreciate the opportunity to be involved in this hearing because we believe very strongly that there is an important role for consortia to play in restoring and maintaining U.S. competitiveness in semiconductors, and in other critical industries.

The SRC is now completing its 10th year and has indisputably demonstrated that cooperative research in a dynamic high technology industry not only can, but does, work very well. In the current international and industrial environment it is essential for U.S. industry, and especially the semiconductor industry, that pre-competitive, cooperative research alliances be formed and funded at a level where they can be effective in rapidly advancing the technology.

Technology advances with or without U.S. direct participation. If we don't aggressively participate, we are quickly left behind. The leading economic powers know that their future status is closely tied to their ability to compete in this high technology environment. They form industry coalitions to exploit emerging technologies. Improvements in manufacturing have been made and continue unabated with new products, new processes, and new services being introduced in an increasingly rapid rate.

Japan, Korea, Taiwan, Singapore, France, Germany, and other countries are now actively involved in formulating and conducting industrial and technology policies to aid their high-tech industry.

To meet the challenges posed by government-industry coalitions abroad, the United States—both its Government and its industry—must respond. If we do not, we jeopardize both our national security and our economic future.

I have included some information in my written statement but it is not my intent to discuss the role and the status of the U.S. semiconductor industry in any detail. You and your colleagues have spent many hours listening to testimony and receiving other information about the importance of the U.S. semiconductor industry. It is clear that in the United States where the semiconductor revolution was born we do not stack up well at the current time against many of our world-wide competition.

There is a trend and it appears ominous. Even more worrisome is the fact that the United States has not kept up in the more fundamental areas of advanced materials technology, advanced semiconductor devices, and perhaps more importantly even, manufacturing science.

My concern, and I am sure that it is shared by many in the room today, is that if we do not take decisive action as a Nation, we may find ourselves at the bottom of the trend lines. And we may find that the slope is much too steep for us to climb out of.

There is no simple solution to the problem and there is no single path that you have to follow. Today the cost in dollars, technical manpower for a Nation to compete effectively so that leadership remains within its grasp now exceeds the resources of any one company, no matter how big, in fact may exceed the resources of any one national industry. The situation is becoming worse with each new generation of technology. The return on investment for re-

quired technology development cannot be justified on an individual company or industry basis.

Consortia play an important policy role in addressing critical national policy issues. The SRC was intimately involved in the creation of Sematech. We were honored to work with the distinguished Chairman of this Subcommittee on the creation of the National Advisory Committee on Semiconductors and we have been involved in Microtech 2000, a proposal under review by the NACS to restore technology leadership by accelerating semiconductor device development by one device generation within the next decade.

The SRC is a successful U.S. research cooperative. In fact, we have come to be viewed as a model by very—by other organizations. Early this year on May 7th, in testimony before the House Appropriations Subcommittee on Defense, Mr. Paul Hazen testified on behalf of the Institute of Electronic and Electrical Engineers which is the world's largest technical professional society. In his testimony he said, "We recommend that Congress encourage the creation of industry sponsored consortia on the model of the Semiconductor Research Corporation to conduct educational research in fields such as magnetic and other critical technologies."

The semiconductor industry has supported SRC very well. Since 1982 the industry has committed over $200 million to its cooperative research program but still the needs still far outstrip these resources. The Government has participated in the SRC since 1986, providing a total direct contribution of about $9 million for research. In the early days of the industry, you must remember, generic semiconductor research was carried out almost entirely by the Government. In 1990, the Government contribution was about four percent of our research budget.

The industry is limited by the amount of resources it can invest in consortia before its ability to provide a continuing flow of competitive products is affected. The SRC has been asked by the industry to address many more needs than its resources will permit. The same is true of other consortia in the semiconductor arena and in others as well. We believe that there are a number of actions which can and should be taken by the Government to encourage and support cooperative research efforts.

First, Government agencies can participate in cooperative efforts. The seven agencies which actively participate in the SRC program do so simply because they benefit from it. These are agencies whose mission involves semiconductor research or in the case of the National Science Foundation, which is one of the seven agencies, graduate education. Personnel from these agencies serve on our committees of the Technical Advisory Board, assist us in setting our long-range goals, and use the results of the research program.

Second, the Government can provide incentives for greater industry participation in consortia. There should be a permanent R&D tax credit and it should be higher for cooperative research efforts. The R&D tax credit should recognize that industry R&D dollars put into cooperative research programs is a way of conserving resources, of obtaining leverage for research investments, of producing far more results than if individual projects are funded on an individual basis. A 50 percent credit for research performed by con-

sortia would not be unreasonable. It would encourage investment, and we believe it would not decrease the amount of general fund tax revenues.

Finally, the Government should provide direct funding for consortia efforts which are directly related to national priorities. A partnership effort is needed if we are going to maintain our world leadership position in critical technologies such as microelectronics. The SRC, for example, has become a prime example of the efficient use of domestic resources to strengthen our technology base. A strong case can be made for the Government to match, on an annual dollar-for-dollar basis, the industry funding of the SRC cooperative research program. For fiscal year 1992 that would mean a matching grant of about 20 million. We ask you to consider this as a proper function of the Advanced Technology Program of the National Institute of Standards and Technology in the Department of Defense—Department of Commerce, excuse me.

Consortia, like the SRC, are an important part of our technology efforts. They have shown that it is possible to bring together leading companies to cooperate and to develop and execute effective research programs. Many of these programs deliver results that positively affect our ability to compete in the world market and to maintain a strong national defense.

There is a legitimate role for the Government and consortia activities. Certainly it can encourage a long-term view. It can enable research to be done that might otherwise be neglected. And it can promote and encourage the building and maintaining of a strong technology base. Stronger Government participation is essential and consistent with its role of providing for our Nation's economic and national security.

I appreciate the opportunity to speak on behalf of the SRC, its member companies and program participants, and I would be happy to answer any questions that you might have. Thank you.

Mr. BROWN. Thank you very much, Dr. Sumney. That's excellent testimony and provokes us to a number of questions but we are going to hold out until we hear from all of the Members of the panel.

[The prepared statement of Mr. Sumney follows:]

SEMICONDUCTOR RESEARCH CORPORATION

STATEMENT OF

LARRY W. SUMNEY

PRESIDENT AND CEO
SEMICONDUCTOR RESEARCH CORPORATION

to the

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

on the

SEMICONDUCTOR INDUSTRY AND THE ROLE OF CONSORTIA

July 23, 1991

Mr. Chairman, Members of the Subcommittee, my name is Larry W. Sumney. I am President and Chief Executive Officer of the Semiconductor Research Corporation, known throughout the industry and the academic community as the SRC. The SRC is a not-for-profit consortium that plans and executes a program of fundamental and applied research at our nation's leading universities in areas of interest to the U.S. semiconductor industry. It is the largest university research program in the country.

We appreciate the opportunity to be involved in this hearing because we believe very strongly that there is an important role for consortia to play in restoring and maintaining U.S. competitiveness in semiconductors -- and in other critical industries.

The SRC is now completing its tenth year and has indisputably demonstrated that cooperative research in a dynamic high technology industry not only can, but does, work.

In the current international industrial environment, it is essential for U.S. industry, and especially the semiconductor industry, that pre-competitive, cooperative research alliances be formed and funded at a level where they can be effective in rapidly advancing the technology.

Technology advances with or without U.S. direct participation. If we don't aggressively participate, we are quickly left behind. Increasing complexity and increasing miniaturization have been the themes in semiconductor technology. Many of us are aware that integrated circuit fabrication, which began in the early '60s with a few masking steps and minimum circuit dimensions measured in tens of micrometers, has now evolved to a level of sophistication requiring hundreds of processing steps and dimensions of tenths of micrometers. The result is that we now require a 100 MIPS (million instructions per second) workstation for chip design and a manufacturing facility (fab) costing nearly $700 million.

The leading economic powers know that their future status is closely tied to their ability to compete in this high-tech environment. They form industry coalitions to exploit emerging technologies. Improvements in manufacturing have been made and continue unabated with new products, new processes, and new services being introduced at an increasingly rapid rate. Japan, Korea, Taiwan, Singapore, France, Germany, and other countries are now actively involved in formulating and conducting industrial and technology policies to aid their high-tech industry.

To meet the challenges posed by government-industry coalitions abroad, the United States -- both government and industry -- must respond. If we do not, we jeopardize both our national security and our economic future.

It is not my intent to discuss the role and status of the U.S. semiconductor industry in detail, and I do not believe this is the purpose of your hearing today. You and your colleagues have spent many hours listening to testimony and receiving other information about the importance of the U.S. semiconductor industry.

Industry Importance

At the request of the Congress, first the Defense Department and then OSTP identified a list of "critical technologies" deserving of federal investment. The Department of Commerce, the U.S. Council on Competitiveness, the Japanese, the European Community have also published lists. All of the lists are virtually identical -- all contain semiconductors.

The electronics industry is now our nation's largest manufacturing industry, with over 2.6 million Americans directly employed. The heart of this industry is its microelectronics technology base. Semiconductors are its basic ingredient. Semiconductors touch every aspect of our lives. We cannot successfully manufacture other products -- steel or stereos, ball bearings or bricks -- without their use in the manufacturing, inventory, and distribution process. Our traditional industries -- textiles, shoes, furniture, and others -- depend on this emerging industry for their future.

Our national defense is based upon the "force multiplier" effect provided by technological superiority. The importance of this was clearly demonstrated in Operation Desert Storm. At the heart of this technological superiority are the integrated circuits that we are focusing on today. Much data has been produced to show that the weapons systems of the future may well depend upon semiconductors manufactured outside the United States by non-U.S. companies.

World semiconductor market growth has averaged 14% per year since 1968 and, at this rate, will reach $200 billion in the year 2000. But the U.S. market share has declined from 75% in 1965 to 36% in 1989, while Japan's share has risen from 10% to 52% in the same time period. In 1986, Japan captured the leadership position.

It is clear that, in the United States, where the semiconductor revolution was born, we do not stack up well against our worldwide competition. The trend is ominous. Even more worrisome is the fact that the United States has not kept up in the more fundamental areas of advanced materials technology, advanced semiconductor devices, and manufacturing science.

My concern, and I am sure it is shared by many in this room, is that if we do not take decisive action as a nation, we may find ourselves at the bottom of the trend lines. And we may find that the slope is too steep for us to climb.

There is no simple solution to our problem, no single path to follow.

The National Advisory Committee on Semiconductors, which was created through legislation introduced by the chairman of this subcommittee, and for which we are most grateful, has called for vigorous federal action to reverse the U.S. industry's loss of market share. Its recommendations address capital

formation, educational reforms, tax incentives, and many other factors. Among these recommendations is a call for increased funding both for SEMATECH and for long-term industrial R&D efforts.

Use of Consortia

This year, NACS is looking at proposals to encourage use of consortia as an important means for technology development. Cooperation at the pre-competitive research and development level is essential, not just for the survival of high-tech industry, but also for the survival of the nation. This is especially true for microelectronics, whose technology is embedded within the products belonging to other technologies.

Today, the cost in dollars and technical manpower for a nation to compete effectively -- so that leadership remains within its grasp -- now exceeds the resources of any one company, no matter how big, and, in fact, may exceed the resources of any one national industry. This situation is becoming worse with each new generation of technology. The return on investment for the required technology development cannot be justified on an individual company or industry basis. Yet, unless an internationally competitive posture is maintained, all fail -- company, industry, and ultimately, the standard of living of the nation.

Of increasing concern is the trend in applied R&D, which has a three- to ten-year horizon and fills that important gap between basic invention and product development. In this critical area the overall rate of increase in spending is slowing. The National Science Board reports that between 1986 and 1989, spending on applied R&D slowed to an average annual growth of only 1%.

In addition, as competitive pressures increase, industry is investing a much larger portion of its R&D budget in product development, at the expense of applied R&D.

At a time when we face limited resources, both financial and intellectual, we must use the resources we have more efficiently. This is the fundamental rationale for consortia.

Consortia such as SRC, SEMATECH, the Microelectronics and Computer Technology Corporation (MCC), and others are designed to address shared problems. By doing so, they reduce duplicative R&D, they speed up development, and they ensure a wider diffusion of research results throughout industry.

The SRC, for example, was created in 1982 to undertake a cooperative, generic research mission at U.S. universities for the semiconductor industry. Its formation reflected the fact that a decreasing amount of university research effort was being placed on fundamental R&D for industry use.

SRC Objectives

To enhance the competitiveness of the U.S. semiconductor industry, the SRC was given four main objectives:

First, to restore the generic research base relating to silicon integrated circuits by identifying the industry's technology needs and implementing a long-range research strategy for meeting those needs. Today, the SRC funds some $30 million in research at over 60 leading U.S. universities and other research organizations. Over half of all the silicon-related research carried out at U.S. universities is funded by the SRC.

Second, to transfer research results to its members on a priority basis. Many different technology transfer and communications techniques are used to move results from the university into member company operations.

Third, to increase the skilled manpower base of the industry. The SRC funds about 25% of the Ph.D. students in electrical and electronic engineering in the United States. Each SRC research contract utilizes a number of graduate students working under the direction of a research professor. Today, we have 672 students working with 247 faculty task leaders. We maintain close contact with these students during their assignments; most are ultimately hired by one of our member companies, by government agencies, or by U.S. universities.

Fourth, to increase cooperation between members, provide technology leadership, and advance and support competitive responses. Working with industry and government, the SRC plays a central role in coordinating the R&D needs of the semiconductor industry. Key semiconductor R&D concerns are identified and appropriate responses are formulated in response to national competitive issues.

Value of Consortia

In this picture of the SRC, you can see several good arguments for the use of consortia:

* **Consortia help avoid duplication of research efforts.** The SRC is charged by its members with developing a long-range research strategy for the U.S. semiconductor industry. Through an extensive planning process, its research program is related to a set of goals that address

the technology needs of the industry in the year 2001. Over 250 people from our member companies serve on the committees of our Technical Advisory Board that help formulate these goals and review and advise the SRC on research in progress. Research funded by the SRC replaces efforts that would be undertaken independently and simultaneously by some of our member companies.

* **Consortia leverage R&D dollars and talent to develop new generic technologies.** One of our biggest shared problems in industry is the cost of capital. At the SRC, annual membership fees range from $500 for our smallest Affiliate to $2.78 million for the largest Member. For their fee, each member has access to $30 million in research.
* **Consortia involve industry, government, and universities working together to meet shared objectives.** The SRC has large companies and start-ups as members. Its membership also includes SEMATECH, MCC, and two national laboratories, Sandia and Los Alamos. Seven government agencies are SRC participants. The SRC provides a meeting place for the exchange of knowledge and ideas for all participants.
* **Consortia play an important role in addressing critical national policy issues.** The SRC was involved in the creation of SEMATECH. We were honored to work with the distinguished Chairman of this Subcommittee on the creation of the National Advisory Committee on Semiconductors. And we have been involved in Micro Tech 2000, a proposal under review by NACS to restore technology leadership by accelerating semiconductor device development by one device generation within the next decade.

The SRC is a successful U.S. research cooperative. We are meeting the goals set for us by restoring a mainstream research effort in our universities and assuring an adequate supply of well-trained scientists and engineers to lead the U.S. semiconductor industry in the years ahead. An environment for knowledge-sharing has been created by our diverse activities, and strong industry-university ties have been developed.

The industry has supported SRC very well. Since 1982, the semiconductor industry has committed over $200 million to its cooperative research program, but the needs far outstrip our resources.

Government Role

The government has participated in the SRC since 1986, providing a total direct contribution of about $9 million for research. In the early days of the industry, you must remember, generic semiconductor research was carried out almost entirely by the government. In 1990, the government contribution was about 4% of our research budget.

The industry is limited by the amount of resources it can invest in consortia before its ability to provide a continuing flow of competitive products is affected. The SRC has been asked by the industry to address many more needs than its resources will permit. The same is true of other consortia in the semiconductor area and in other areas.

We believe that there are a number of actions which can and should be taken by the government to encourage and support cooperative research efforts.

* **First, government agencies can participate in cooperative efforts.** The seven agencies which participate in the SRC program do so because they benefit from it. These are agencies whose mission involves semiconductor research or, in the case of the National Science Foundation, graduate education. Personnel from these agencies serve on the committees of our Technical Advisory Board, assist in the setting of long-range research goals, and use the results of the research program.
* **Second, the government can provide incentives for greater industry participation in consortia.** There should be a permanent R&D tax credit. And it should be higher for cooperative research efforts. The R&D tax credit should recognize that industry R&D dollars put into cooperative research programs is a way of conserving resources, of obtaining leverage for research investments, of producing far more results than if individual projects are funded on an individual basis. A 50% credit for research performed by consortia would not be unreasonable. It would encourage investment, and, we believe, it would not decrease the amount of general fund tax revenues.
* **Finally, the government should provide direct funding for consortia efforts which meet national priorities.** A partnership effort is needed if we are to maintain our world leadership position in critical technologies like microelectronics. The SRC, for example, has become a prime example of the efficient use of domestic resources to strengthen our technology base. A strong case can be made for the government to

match, on an annual dollar-for-dollar basis, the industry funding of the SRC cooperative research program. For FY 1992, that would mean a matching grant of about $20 million. We ask you to consider this as a proper function for the Advanced Technology Program of the National Institute of Standards and Technology in the Department of Commerce.

Conclusion

Consortia like the SRC are an important part of our national technology efforts. They have shown that it is possible to bring together leading companies to cooperate and to develop and execute effective research programs. Many of these programs deliver results that positively affect our ability to compete in the world market and to maintain a strong national defense.

There is a legitimate role for the government in consortia activities. It can encourage a long-term view. It can enable research to be done that might otherwise be neglected. And it can promote and encourage the building and maintaining of a strong technology base. Stronger government participation is essential and consistent with its role of providing for our nation's economic and national security.

I appreciate the opportunity to speak on behalf of the SRC, its member companies and program participants, and I would be happy to answer any questions.

SRC
COOPERATIVE RESEARCH

Members

Advanced Micro Devices
Alcoa
AT&T
Control Data
Digital Equipment
Du Pont
Eastman Kodak
Eaton
E-Systems
Etec Systems
General Motors
Harris
Hewlett-Packard
Honeywell
IBM
Intel
LSI Logic
M/A-COM
Micron Technology
Motorola
National Semiconductor
NCR
Rockwell International
Texas Instruments
Union Carbide
Varian
Westinghouse
Xerox

Associate Members

Los Alamos National Laboratory
MCC
Sandia National Laboratories
SEMATECH

Affiliate Members

Advanced Technology Applications
Analogy
Dawn Technologies
Epic Design Technology
Hampshire Instruments
Hestia
Integrated Silicon Systems
Intersonics
Jamar
Mission Research
nChip
Peak Systems
Process Technology
Prometrix
QuanScan
Rapro Technology
Sienna Technologies
SILVACO Data Systems
Solid State Equipment
Technology Modeling Associates
Techware Systems
Tyecin Systems
Unit Instruments
VLSI Standards
WYKO
XMR

U.S. Government Participants

Army Research Office (ARO)
Defense Nuclear Agency (DNA)
National Institute of Standards and Technology (NIST)
National Science Foundation (NSF)
National Security Agency (NSA)
Office of Naval Technology (ONT)
Wright Laboratory

6/12/91

Mr. BROWN. Dr. Rodgers, Dr. T.J. Rodgers?

STATEMENT OF T.J. RODGERS, PRESIDENT AND CEO, CYPRESS SEMICONDUCTOR CORPORATION, SAN JOSE, CALIFORNIA

Dr. RODGERS. My real name is Thurman, that's why I use my initials.

Thank you, Chairman Brown and Members of the Committee, for inviting me.

This is the third year in a row I've been in Washington on your sultry summer days to testify about American competitiveness in a debate which seems to me to be frozen in time. We keep talking about the pluses and minuses of consortia while the fundamental realities of the semiconductor industry are changing, so today I'd like to talk about what the semiconductor is like, not perceived to be, before I discuss the various proposals. Then I'd like to talk about the real two biggest problems we have, the cost of capital and the short term mentality of our financial markets—the capital gains laws—and provide two concrete solutions that you can do this year, change the capital gains laws—I didn't say lower them, I said change them—and get rid of the Glass-Steagall Act of 1933.

The new reality in the semiconductor industry is that the industry is alive and well. We keep looking at Dataquest statistics which says in 1982 we were ahead of the Japanese by more than 10 percentage points and that by 1989 we were behind the Japanese by more than 10 percentage points. What we failed to recognize in those statistics is that the yen/dollar exchange rate is built into them and of the 37 points of relative decline between Japan and America during that period of time, 25 of those points are explained by currency exchange rates.

Mr. BROWN. What were those figures again?

Dr. RODGERS. Of the 37 percentage points of relative decline between the Japanese and American semiconductor industry between 1982 and 1989, 25 of the 37 points is an artifact of currency exchange rates which are built into the figures.

Now, if you fix the exchange rate at 144, which is the last reported year, and recast the figures, that's the worst case. It makes all of America's numbers look worse. And if you look at those figures you come to the conclusions that I have and they are the following: The decline of the American semiconductor industry started in 1979, in market share it ended in 1985 and there was a steep decline. In the last six years from 1985 to 1990 we have not lost any market share to the Japanese, and as a final piece of good news, in 1990 we gained back market share from the Japanese, both real and as an artifact of an up-tick in the exchange rate. So our industry is not dying, we do need help but we don't need urgent action especially if it causes something to happen that won't help us.

The new reality in the semiconductor industry is that small is good. In the same year in 1990 that the semiconductor industry took back ground from the Japanese, in that same year six of our eight largest semiconductor companies lost money. The conclusion? The big guys in the semiconductor industry at large are no longer the same. We can't conclude in analogy what's good for General Motors is good for America any longer in the semiconductor indus-

try. In the most recent issue of the Harvard Business Review, five semiconductor companies were analyzed, new people, people who's names you may not have heard of, Altera, Chips and Technologies, Weitek, Xilinx, Cirrus Logic. Together these start-ups have sales of $620 million profits, of $65 million per year, and a market value of $1.4 million. We are not talking about an industry that is about to disappear.

The world has changed but some of the giants in our industry are still using a play book that was developed in the 1970s to fight the game in the 1990s. It's in the light of this new reality that I'd like to discuss the various proposals that are before us. Consortia, at best, consortia are a facilitating tool which can help the semiconductor industry. And I would name three consortia that I think do a good job, the SRC right next to me here, SEMI, and the MCC. Each of them has very little Government funding, came about on their own, and does a good job. As a matter of fact, my company Cypress Semiconductor recently joined the MCC.

Sematech is a very expensive subsidized consortium which I believe is a wrong answer out of the old play book. In the interests of time—to get on to suggestions that I think will help—I'll make only three points about Sematech here today. Number one, Sematech discriminates against most American semiconductor companies, especially small ones, with their dues structure. Their advertising is come one, come all, pay one percent, join up, the reality is a $20 million company has to pay 10 times higher dues than a $3 billion company as a percentage of sales to join Sematech because the dues are skewed to tax the small and give a break to the big guys.

Second point—and this is new—Sematech is using hold-back contracts on equipment manufacturers. Chartered to develop equipment for the American semiconductor industry, Sematech is giving money to American equipment and then contractually, in writing, requiring some of them to hold back that equipment from American semiconductor manufacturers for a period as long as a year. Does that sound fair especially when tax money is being used?

And finally we're getting kick-back contracts from Sematech, Sematech is giving contracts back to its own members. For example, in a recent contract, Sematech gave back approximately $3.4 million to Intel to work on a machine that every semiconductor company would have worked on anyway. That represents a 23 percent reduction in Intel's dues, a subsidy on a subsidy hardly needed by a corporation which made $650 million of profit last year.

The real problem, the cost of capital. The cost of capital is too high. Americans invest two percent of gross domestic product, the Japanese and Germans, three percent. Why do we have that problem? The culprit, as you well know, is Government deficit spending. When the Government spends too much, it borrows money, the money drives the interest rates up. In that period of decline I talked about earlier, we were suffering 12 percent interest rates, the Japanese, four percent interest rates—eight percentage points of differential.

What does that mean to a company like mine? Our average chip costs 28 cents to make, I can buy the silicon, copper, plastic and gold for 28 cents. But the equipment that we have to have to make

the chip, the interest—the cost of capital on that equipment—is 56 cents, twice as much as everything in the chip. It turns out that if the industry raised the cost of the silicon wafers we buy by a factor of two, that would have less impact on our bottom line at Cypress than raising the interest rate by just two percentage points. Therefore operating at an 8 percentage point disadvantage to the Japanese is a big deal and we've got to change that.

The short term mentality of our capital markets is a big problem. The other day we reported to Wall Street. The way we do that these days is a teleconference, I talk to Wall Street, San Francisco and Boston at the same time, the Chief Financial Officer and I give out the numbers. We reported great numbers, record sales, record earnings, good bookings. The response? Thirty seconds of thank you for the quarter and 90 minutes of questions about how are you going to do on the next 90 days, is there a lull in the August orders, did you get the new microprocessor designment, I heard your plant down in Texas is having yield problems, how is the next 90 days going to go?

I hung in there and it turns out our stock shot up $2 within an hour after the end of that meeting and I thought, well, the system works, maybe good news brought good results. I called our specialist on the floor of the New York Stock Exchange and I said, how come our stock went up? And he said, "oh, there were two short sellers out there. They had sold a bunch of your stock before your meeting hoping that you would have bad news and the stock would go down and they could make a killing". So much for the long term mentality of our markets, we've got to change it.

A change in the capital gains tax would fix both the short term mentality problem and also help the cost of capital problem. Congressman Campbell, who I believe is on this Committee, has proposed a capital gains plan in which long holders of equity would be given a tax break. So for the first two years people would pay the current capital gains tax and after that they would pay half of the current capital gains tax up to five years and after five years there would be zero tax on capital gains. That's a step forward but in my experience it has a fatal political flaw and that is it's going to get labeled a "tax break" for the rich, and that's the end of it.

So I have a different proposal today for adjusting, not lowering, the capital gains. For the first six months, please, raise the capital gains tax rate. Raise it by 50 percent. Let's soak the rich, let's soak the traders and rumor mongers and flippers on Wall Street. For the next two and a half years let the capital gains rate be what it is now, but after three years let the capital gains rate be zero. So the money we take from the rich traders on Wall Street we can give to the little guy to invest in the market for the long term. That would make a difference. And it would make more difference not just in the money that would flood into our industry, but in the mentality of Wall Street that would be forced to ask the question "are you going to be the best semiconductor company three years from now?" As opposed to, "How are orders for the next quarter going?" Which is the environment we are in today.

We need to get rid of the Glass-Steagall Act of 1933. It is a dinosaur that was useful then but is not useful now. That act as well as the Bank Holding Act of 1956 prevent banks, in effect, from put-

ting money into the semiconductor industry by preventing banks from both having equity and dept in the semiconductor and other industries at the same time. And the problem is the semiconductor industry is risky enough that you have to have both equity and dept to create a financial structure that allows banks to pump their money in. That law has got to go away. Both Japan and Germany allow their banks to invest in the infrastructure of their industries and we prevent it with a law from the depression era.

So to conclude. I like consortia, especially the ones that form on their own and pay for themselves. And if you wanted to do two things this year that are doable to help our industry, restructure the capital gains tax to penalize the short traders and give the benefit to the long term share holders, and get rid of the Glass-Steagall Act so that the huge amount of money we have in our banks can move into the infrastructure of our manufacturing economy.

Thank you very much for hearing my statement.

[The prepared statement of Dr. Rodgers follows.]

HOUSE COMMITTEE ON SCIENCE, SPACE,

AND TECHNOLOGY

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS

JULY 23, 1991

"SOME CONCRETE PROPOSALS TO MAKE THE SEMICONDUCTOR INDUSTRY MORE COMPETITIVE"

STATEMENT OF DR. T.J. RODGERS

PRESIDENT AND CEO

CYPRESS SEMICONDUCTOR CORPORATION

SAN JOSE, CA

Two summers ago I appeared before a House Judiciary subcommittee. Last summer I appeared before a Senate Judiciary subcommittee. Both of those hearings, like today's hearing, concerned the health of the U.S. semiconductor industry, the future of the antitrust laws, and the role of consortia in building American competitiveness. This is a debate that just will not go away. It is also a debate that seems frozen in time. In many respects Washington has been conducting the same discussion about semiconductors for the last five years--even as some of the industry's most basic technologies and economics have experienced profound transformations.

I would like to take a new approach this morning and begin with an overall perspective on the history and future of the U.S. semiconductor industry. After all, Congress cannot prescribe the right solutions if it is working on the wrong problems. I will then discuss how and why some of today's consortia help the semiconductor industry--and explain my continued opposition to the structure and policies of Sematech. Next, I will offer two new proposals to address the most serious competitive problem facing our industry--the damaging financial environment in which we operate. I will conclude with some general comments on the antitrust laws and the explosion of litigation that is damaging our industry.

Let me begin with a proposition seldom voiced on Capitol Hill by the CEO of a semiconductor company: The American chip industry is quite healthy right now. We have all heard the conventional view of the "crisis." According to industry-watcher Dataquest, the United States held 54% of the worldwide semiconductor market in 1982 while the Japanese held 34%. By 1989, the Japanese had increased their share to 52% while the U.S. share had slipped to 35%. Thus, in just seven years, there was a 37-point reversal in market share between Japan and the United States.

Those figures are troubling, but they obscure as much as they illuminate. This dramatic market-share reversal is based on nominal revenues rather than volumes. In fact, the figures reflect currency exchange rates more than they do underlying competitive strength. If we use a constant yen-dollar exchange rate and restate the figures, the trend from 1982 through 1989 looks much less dire. Using the near-worst-case 1990 rate of 144 yen to the dollar, Japan held 47% of the world semiconductor market in 1982 while the United States held 43.5%. By 1989, the Japanese share was 51% while the U.S. share was 36%.

In other words, using an apples-to-apples comparison, it turns out that 25 points of the 37-point market-share reversal cited by the "doom-and-gloom" school reflect currency fluctuations rather than true competitiveness. These adjusted trends are nothing to celebrate, but they offer a less distorted picture than the nominal statistics.

I would argue that the United States and Japan have been in a state of dynamic equilibrium since 1987. During this period, Japan has gained no ground on the United States in semiconductors: Japan's worldwide market share has hovered within 2 points of 50% while the U.S. share has hovered within 2 points of 37%. The current equilibrium represents a balance between two ongoing battles. One battle is over manufacturing, which the Japanese have been winning but in which we are making a strong comeback. The other battle is over innovation, which the United States has been winning and continues to win.

The good news is that America's progress in manufacturing is moving faster than Japan's progress in innovation--it has proven easier for us to learn well-documented manufacturing techniques than for them to restructure their rigid economic system. Indeed, last year, the United States *gained back* semiconductor market share from the Japanese (based on either

variable or constant yen-dollar accounting.) I expect the United States to continue to gain ground over the next five years--optimistically, to win back as many as six market-share points; pessimistically, to hold what we have. America's slide began in 1979 and ended in 1985. Let's stop trying to rectify ancient history!

That said, we should question even the value of aggregate statistics. Using a single market-share figure to measure the health of the entire "U.S. semiconductor industry" is an exercise in dangerous over-simplification. The DRAM memory chip market, the largest market segment and the one most thoroughly dominated by the Japanese, greatly distorts the figures. DRAMs are a brutal commodity business in which even the most efficient Japanese producers are suffering from internal competition and recent Korean entry. On the other hand, microprocessors, the central engine of the computer revolution, remain the most technologically exciting and consistently profitable segment of the chip business--and their design and production is thoroughly dominated by American companies. Finally, when you look at present and future generations of specialized logic chips--math processors, digital signal processors, video processors--innovative American companies are leading the way at every turn. Viewed as a country or as a group of companies, the United States is positioned precisely where it wants to be--dominating the high-value, high-margin, innovation-driven parts of the business.

I certainly do not deny that our industry has competitiveness problems. But the most severe problems are concentrated in the large, established, high-profile companies associated with the industry's early days--giant companies that will have to change or become dinosaurs. Indeed, last year, despite *gains* in worldwide market share by the United States, six of America's eight largest chip companies *lost money*. These results are vivid evidence that the old guard companies

that have been identified as "the U.S. semiconductor industry" can no longer be used as a true barometer of our industry.

The balance of power in semiconductors--as in the whole of electronics--is shifting away from many of the big, established companies toward smaller, nimble companies focused relentlessly on innovation and quality. Corporate size is no longer an intrinsic asset in competing with Japanese conglomerates. In many cases, it is a liability.

Think about microprocessors. Five years ago, Intel (then a $1 billion company) and Motorola (then a $3 billion company) talked publicly about how the Japanese threatened their leadership position in microprocessors. What really happened? Small, aggressive U.S. companies--not the Japanese--took market share. The most exciting developments in microprocessors are the new RISC architectures from Sun Microsystems and MIPS Computer Systems. My company is shipping a powerful new microprocessor based on Sun's SPARC architecture. Intel and Motorola have been unsuccessful in responding with their own RISC processors. Meanwhile, the Japanese giants are still trying to figure out how to respond to this blizzard of innovation.

Five years ago, if someone had asked me whether Cypress Semiconductor could enter the microprocessor market, I would have said we could not afford the massive resources such a move would require. But the game has changed dramatically. Ever-increasing computer power (essential to designing new chips) means that ever-smaller companies can play and win against the giants. With 22 employees and a total investment of only $7 million, Ross Technology, a tiny subsidiary of Cypress, brought to market a chip set more powerful than the Intel 80486. More than ever, the future of U.S. technological competitiveness rests with this country's

entrepreneurs.

There is a new strategic logic to success in the semiconductor business: think small, think flexible, think efficient. Unfortunately, this is not the logic accepted by the old guard. These companies continue to rely on the incorrect premise of economies of massive scale and political protection--in manufacturing, in trade laws, and in wasteful litigation over intellectual property. Even the Japanese are due for a come-uppance. Japanese factories do very well with high-volume, medium-performance products engineered for relatively easy manufacturing. But our business is getting more fractionated, more specialized, and more complicated all the time. *Japan's fabulous achievements at disciplined mass manufacturing will provide its companies with less and less of an advantage in the future.*

We do not need a few more government-subsidized "battleship" fabs and a handful of giant companies to compete head-on with the Japanese. Rather, we need hundreds more small, flexible, innovative companies to wage slashing raids at Japan's weakest points. The lead article in the July-August 1991 issue of the *Harvard Business Review* makes just this point. As the authors state: "Dramatically changing technology and economics have made obsolete the traditional model of semiconductor production--a model built around high-volume wafer fabrication and vertical integration. Most large established U.S. manufacturers have chosen to ignore or resist this unsettling new reality. They have suffered dearly as a result. But a new breed of companies and a few members of the establishment have embraced the industry's transformation. These companies have succeeded spectacularly in revenue growth, profits, and technology leadership."

To document their argument, the *HBR* authors combine the 1990 financial results of five

innovative, young semiconductor companies: Altera, Chips & Technologies, Cirrus Logic, Xilinx, and Weitek. Together, these companies had 1990 revenues of $620 million, net income of $65 million, a market value of nearly $1.4 billion and a pretax return on equity of more than 26%. These results hardly portray an industry under siege.

Cypress's history reinforces the argument. We founded the company in 1983 and went public in 1986. We have never had a losing quarter since we first turned a profit in 1985. We now generate revenue at an annual rate of $300 million and consistently register profit margins of more than 20% of revenues. We have succeeded precisely because we have not needed half-a-billion-dollar fabs or $100-million microprocessor development budgets. Yet even the toughest of our American competitors would give credit to our technology and microprocessor capabilities.

Last year Cypress ran its entire business with just two factories that together cost less than $80 million. Our wafer fab in San Jose, California, opened in 1984. It was completed in seven months from construction to the time we shipped our first revenue wafer. On a total investment of $40 million, this fab generates $90 million a year in revenue, runs almost 60 different products manufactured in 26 different processes, and does all of Cypress's R&D.

Our fab in Round Rock, Texas, opened in a used building in 1986. Eight months transpired from the time the wrecking ball wiped out the middle of the building (we left the walls up) until the time Cypress Texas shipped its first revenue wafer. Our investment is $40 million. The factory is now generating revenue at a rate of $210 million per year and still runs at only 50% capacity. Both fabs manufacture products in state-of-the-art, sub-micron technology.

My point is not to boast about Cypress's performance. Many of our entrepreneurial

rivals--companies such as Integrated Device Technology and Micron Technology--have exemplary competitive track records. My point is to underscore the new realities of competition in the semiconductor industry. You cannot win the competitive battles of the 1990s with a strategic playbook written in the 1970s. The game has changed. Unfortunately, the giants that dominate the debate in Washington are still calling plays from yesterday's playbook. I cannot emphasize this point strongly enough: If we continue to shape government policy based on what is required to prop up sagging companies, we will make the wrong policy decisions.

Consider an analogy with the computer industry. Ten years ago, the leaders of the U.S. computer industry were IBM and the five "BUNCH" companies: Burroughs, Univac, NCR, Control Data, and Honeywell. Today the BUNCH has been virtually eliminated from the competitive scene--but the U.S. computer industry, driven by the rise of new companies such as Apple, Compaq, Dell, and Sun Microsystems, has increased its global leadership position. A similar process of "creative destruction" is underway in the semiconductor industry. I do not believe the giant companies in our business will disappear, but the main engines of innovation, growth, and profitability will be the new, hungry, entrepreneurial players.

This entrepreneurial perspective on the health of the U.S. semiconductor industry relates directly to the issue of consortia--an issue with an enthusiastic following in Washington these days. Although I do not oppose the basic idea of consortia as a tool to improve U.S. competitiveness, I do not consider them an especially powerful tool. But structured correctly, with the right members and the right agenda, they can make a contribution.

Here is a quick review of how some consortia help our industry:

o The Semiconductor Research Corporation (SRC) makes some important contributions

to education. It helps bright students work on relevant projects and thereby increases the supply of graduates with advanced degrees in fields relevant to our industry. The SRC operates without taxpayer subsidies.

o The Semiconductor Equipment and Manufacturing Institute (SEMI) has made some real contributions in areas such as technical standards. For example, its Standard Machine Interface (SMIF) allows manufacturers to use robots to move wafers from one machine to another in an environmentally clean production environment. SEMI, like the SRC, operates without taxpayer subsidies.

o The Microelectronics & Computer Technology Corporation (MCC) began eight years ago with delusions of grandeur--massive budgets and annual membership fees of $1.5 million. Over the last few years its structure and research agenda have evolved to serve its market well in several areas of computer research, including the critical field of interconnection. Two weeks ago Cypress became an associate member of MCC--a clear sign of our support. Like SRC and SEMI, MCC operates without taxpayer subsidies.

Granting the contributions of these three consortia, Sematech remains the wrong answer to the wrong problem. It equates the health of our industry with the fortunes of a handful of giant companies, some of which are models we avoid following--the companies that lost market share to the Japanese to begin with.

In the interest of brevity, let me offer just three specific criticisms of Sematech's structure and policies:

1. Sematech's membership policies discriminate against many of the companies that are leading America's comeback. Sematech's advertised dues of one percent of sales actually have

a $1 million per year minimum. That means a $20 million company pays dues equal to 5% of its sales--perhaps all of its profits and five times the dues for a company with revenues of more than $100 million. What's more, Sematech dues top out at $15 million per year, which means that companies with sales of more than $1.5 billion receive a dues discount. Thus, a Sematech member with $3 billion in sales pays dues equal to one-half of one percent of its sales--or *one-tenth* the rate of a $20 million company.

Sematech's dues structure deliberately discriminates against America's small semiconductor entrepreneurs. Is it any wonder that only 14 of America's hundreds of chip companies have chosen to avail themselves of the federal government's generosity? Or that 12 of Sematech's 14 members are giants with annual sales of more than $1 billion? Ultimately, Sematech looks less like an "industry consortium" than an exclusive Corporate Country Club.

2. Sematech policies harm its non-members--even American non-members. Sematech uses taxpayer money to aid its old-guard members at the expense of innovative new companies. There is no more troubling an example of this phenomenon than the equipment hold-back contracts that Sematech has imposed on some of the semiconductor-equipment producers it supports.

Let me share a brief story. A year ago Cypress attempted to buy a wafer polishing machine from a company called Westech in Phoenix, Arizona. We sent a group of engineers to meet with the company. They reported back that something seemed strange. They felt they were not getting access to Westech's most advanced equipment. Ordinarily, when a small equipment company like Westech gets a chance to do business with a new customer, it leaps at the chance to show its newest and best equipment. I called the president, but the issue was never

resolved.

Recently, I got my answers. Sematech's development contracts with Westech on the new polishing machine require contractually that Westech withhold this equipment "for a period of one year from the time of normal introduction" from all but Sematech's members. This hold-back restriction on taxpayer-funded equipment is outrageous--especially in light of Sematech's recent public-relations maneuvers. A month ago the Semiconductor Industry Association denounced a group of Japanese semiconductor equipment companies for withholding their most advanced production equipment from American companies--charges that have withered under scrutiny. Now we discover that Sematech itself is withholding from American companies equipment financed by American taxpayers!

3. Sematech uses kick-back agreements to reduce the financial contributions of its members--and again tilts the playing field against successful U.S. rivals. Recently, Sematech contracted with one of its own member companies, Intel, to purchase and test equipment that Intel probably would have acquired itself. Under the agreement, Intel received--for free--a $1.5 million AMP-5000 wafer-etching machine. It also received a grant of $700,000 to install the etcher and an additional $1.2 million to evaluate it. In effect, this kick-back agreement amounts to a 23% reduction in Intel's annual Sematech dues--a government subsidy hardly needed by a company that earned $650 million last year.

My company also evaluated the AMP-5000 etcher. Well before Intel acquired its etcher, we bought the second AMP-5000 sold in the United States and only the nineteenth sold in the world. We paid the full $1.5 million for the equipment. We spent $500,000 to install it. It took us two years--and about $5 million--to work out the bugs so the etcher would operate at the

quality level demanded. Cypress paid dearly to make it work. Intel received the same equipment for free.

Unless Sematech's policies and practices receive careful scrutiny, they will inspire similar programs--like U.S. Memories, the ill-advised next step. Fortunately, U.S. Memories never took off because the industry saw it as a poor investment. Today Congress is being asked to evaluate another proposal, Microtech 2000, in which the U.S. government would put up $1 billion to create yet another wasteful Amtrak of the semiconductor industry.

If the dynamics of our industry have changed and if high-cost government programs are ineffective, how can the U.S. government support not just the giants but also the nimble, entrepreneurial companies that are making gains in world markets?

Most importantly, government should not involve itself directly in the details of our business. The semiconductor industry is far too complicated for any one agency (or even a group of companies like Sematech) to make the right decisions consistently. Government support must be institutional--designed to create a rising tide that lifts all boats. The proposals that follow reflect this "generic" approach.

One factor critical to the success of the semiconductor industry has inspired much rhetoric, but generated little or no real action in Washington. The members of Sematech often warn (with justification) of the erosion of our "manufacturing infrastructure"--the chain of production from raw silicon through capital equipment, wafer fabrication, assembly and test. One major cause of the erosion of our industry's manufacturing infrastructure is the damaging state of America's *financial* infrastructure--the scarce supply of reasonably priced capital that successful companies need to build their manufacturing muscle. The federal government can

help us achieve two critical objectives: to lower the cost of capital and to extend the time horizons of our investors.

The ambiguous and over-used term "cost of capital" means different things to different people. Troubled companies often use it to explain away bad management or poor investments. In our industry, however, the capital problem is real and severe. The Council on Competitiveness reports that Japan and Germany invest on the order of 3% of their Gross Domestic Product (GDP) in civilian R&D. The United States invests less than 2% of its GDP in civilian R&D. Thus, our two leading rivals out-invest us by more than 50%--a huge handicap in high-technology competition.

The single most damaging "tax" the federal government imposes on our industry is deficit spending. We all understand the vicious cycle in which massive government borrowing drives up the cost of corporate borrowing--with a major impact on a capital-intensive businesses like semiconductors. During the early 1980s, a period of steep market-share erosion for the U.S. chip industry, American companies were paying 12% interest rates while the Japanese were paying 4%. The average cost of the silicon, plastic, copper, gold, and all other raw materials in a Cypress chip is only about 28 cents. Our capital costs--the money we borrow to build our factories--average about 56 cents per chip. In other words, our manufacturing costs are much more heavily influenced by the cost of money than by the cost of silicon. *Doubling the cost of the raw silicon wafers we buy would have less of an impact on our bottom line than raising the interest rate we pay by only two percentage points.*

Government borrowing also hurts our access to the equity markets. The average price-earnings ratio for a high-tech issue on the New York Stock Exchange is about 15. In Tokyo it

is about 60. Therefore, U.S. companies must sell four times as much stock as comparable Japanese companies to raise the same amount of money. Consider the example of NMB, a third-tier Japanese semiconductor company that is a subsidiary of a Japanese ball-bearing company. NMB manufactures well, but compared to Cypress it has a narrow range of products, no marketing, little process development, no product development, and almost no sales capability. Yet NMB raised $472 million in a single public offering two years ago. Cypress, a well-funded company by American standards, needed six stock offerings to raise just $150 million. How can our entrepreneurs compete over the long term when highly regarded U.S. companies struggle for capital while third-tier Japanese companies effortlessly raise huge sums?

The short-term mentality of our financial markets is real, hurts American manufacturing, and is encouraged by our current tax system. A week ago we released financial results for the second quarter over the business wire and through a direct teleconference presentation. The results were very encouraging: record revenues, record earnings, and good news on orders. I wanted Cypress employees to see first-hand how Wall Street thinks--in particular, how uninterested the markets would be in our strategy and achievements as opposed to our short-term outlook. One thousand Cypress employees gathered in an auditorium to listen to our teleconference report. Participating in the call were the representatives of about 65 of our major investors, accounting for more than half of our outstanding shares.

These investors spent literally 30 seconds talking about what we had achieved in the quarter. They spent only a little more time talking about our long-term strategy. Nearly all the questions concerned what would happen over the next 89 1/2 days--until our next quarterly results would appear: Did we have any yield problems? Would our RISC microprocessor

continue to sell at current rates? Would we feel the usual summer lull in semiconductor orders? Our employees were taken aback by the short-term view of our investors, but this is the financial environment in which we must operate every day.

Many of our investors are smart and well meaning. They are forced into the quarterly mentality so as not to suffer a disadvantage relative to other investors. Indeed, when we finished the conference call, our share price shot up almost 10%. We checked with our specialist on the New York Stock Exchange. He explained that the stock rose because of "short covering" by speculators who had sold our shares in advance of the teleconference, in essence betting that we would report bad news.

The two proposals that follow are designed to increase the availability of capital and to reward long-term investors.

1. Restructure the capital gains tax to punish short-term speculation and to encourage long-term investment. (Please note: I did not say lower the capital gains tax.) I have always been a public advocate of reducing taxes on capital gains, but I have always had certain economic and political reservations about that move. Roughly two-thirds of our investors are institutions. Since most of them are tax-exempt, reducing the tax on capital gains will create few incentives for them to invest more in our industry. As for politics, there remains the almost-insurmountable belief in Washington that any reduction in capital gains is a "tax break for the rich." In reality, a tax break that steers the money of the rich into America's manufacturing infrastructure is an excellent policy. Unfortunately, the political reality is that "tax breaks for the rich" will not pass.

Many people oppose lowering the tax on capital gains, but everyone should be interested

in changing the behavior of investors and extending their time horizons. We should reform our financial infrastructure to encourage people to invest responsibly in America's manufacturing infrastructure. We need an environment in which investors have strong incentives to invest for the long term--and in which American companies finally have the freedom to operate with the long term in mind.

This restructuring proposal is hardly the first to look at capital gains from a time-horizons perspective. For example, Representative Tom Campbell has introduced HR 2523. Under his plan, capital gains realized within six months would be taxed at current rates. Any gains realized between six months and five years would also be taxed at current rates, but half the gains would be excluded from taxation. Gains on assets held for more than five years would be completely exempt from taxation.

The Campbell proposal is clearly an improvement over the status quo. However, I would modify it to overcome the "tax breaks for the rich" argument. First, we should *increase* the capital-gains rate on assets held for less than six months by imposing a 50% surcharge over the nominal rate. This surcharge would be a stiff disincentive to wasteful speculation. It would allow us to "tax the rich"--at least the rich who play hunches, trade on rumors, and churn investments to the detriment of the American economy. Assets held between six months and three years would be taxed at the current rate. Capital-gains taxes on assets held for more than three years would be totally eliminated.

Think of how radically these reforms would change investor perspectives. A short-term speculator would pay a huge tax on a capital gain relative to someone willing to invest over a three-year horizon. Somehow I think our quarterly conference calls would take on a different

character if these provisions were in place. The questions would gravitate toward determining whether our company was positioned, managed, and funded to be a leader over the next three years rather than the next quarter. This reform would also lure the "little guy" back into the stock market. Small investors willing to make patient equity investments with their savings or retirement funds would enjoy returns free of taxes.

2. Abolish restrictions in the Glass-Steagall Act of 1933 and the Bank Holding Company Act of 1956 that forbid banks from owning equity in industrial companies and limit bank holding companies to no more than 5% of an industrial company's total shares. The regulations governing our banking system have created a "missing link" in the financing sources available to fast-growing technology companies, especially manufacturing companies. These regulations may have been appropriate for the realities of the U.S. economy after the Depression, but today they do grave harm.

Venture capital is America's high-technology saving grace. There is no shortage of venture capital to get smart ideas off the ground. No good engineer in Silicon Valley will be refused his or her first $10 million to prove the feasibility of a new technology or product. The problem comes at the next stage, when the company needs its second or third $10 million to build a plant and acquire real manufacturing muscle. As a venture capitalist myself and as an outside director with other companies, I have seen this phenomenon first-hand. This "mezzanine" financing stage is where so many good technology companies run out of capital--or run into the arms of cash-rich Japanese corporations that acquire valuable American technology for no other cost than investing. My own company had to raise money in Europe, and I serve on the board of a company that sought Japanese funds after several futile efforts in the United

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States.

Venture capitalists cannot fund the large mezzanine investments that high-technology manufacturers demand. The two-to-one return associated with these risky investments is far below the return venture capitalists require to stay in business. Mezzanine funding is the "missing link" I discussed earlier. In fact, government subsidies for programs such as Sematech or the ill-fated Consumer Electronics Capital Corporation are essentially designed to bridge that financing gap. But why turn to taxpayer subsidies when government could help create a mezzanine funding industry every bit as successful as the venture capital industry is in seed funding?

Commercial banks could play a much larger role in funding new semiconductor companies. Today banks cannot lend to start-up semiconductor companies because they cannot feasibly charge the 20%-50% interest rates necessary to compensate for the risks of bankruptcy. Ordinarily, high-risk loans are accompanied by warrants for the company's stock to increase the rate of return on the loan while keeping the interest rate reasonable. For the last decade such mezzanine financing has been an important source of funds for the leveraged buyout movement--insurance companies and other institutional investors have provided billions of dollars of convertible debt, bonds with warrants, and other debt-equity hybrids. Yet we do not allow our banks to offer similar kinds of financing to America's high-technology community.

The proposals on capital gains and Glass-Steagall are intended as new contributions to the debate over the future of the U.S. semiconductor industry. I would like to conclude with brief comments on three other issues that have been under debate for some time:

1. Congress should make permanent the R&D tax credit. The "temporary" R&D tax

credit has been in place since 1982. The semiconductor industry now takes it for granted and makes its investment plans accordingly. Making the tax credit permanent would not actually change the status quo. Reducing or eliminating the credit would be devastating, and would exacerbate the industry's financial problems.

2. Congress should not gut the antitrust laws as they apply to production consortia. In 1984, the National Cooperative Research Act reduced antitrust penalties on research consortia from treble damages to single damages. Now Congress is being asked to consider the National Cooperative Production Act, which would reduce antitrust penalties for manufacturing consortia. The logic of this legislation is elusive: the penalty reductions are relevant only *if consortia are convicted of violating the antitrust laws*. Do any of us really believe that America's competitive future rests with reducing fines on corporate lawbreakers? Moreover, what is the logic of demanding "fair play" and "fair trade" with our foreign competitors while making it less costly for the giants to engage in unfair practices within the United States?

3. Congress should create disincentives for frivolous and harassing lawsuits filed under the banner of "protecting intellectual property." Many large companies in our industry are in the midst of a litigation frenzy. For example, AMD and Intel have probably spent at least $1 million a month during their three-year legal war over rights to the 80386 microprocessor. With that same amount of money, AMD and Intel could have funded Cypress and each owned half of what is now an $800 million asset! Texas Instruments has a stated policy to sue dozens of companies to generate new revenues. It actually assigns particular patents to individual lawyers who run profit-and-loss centers designed to maximize earnings off those patents. Meanwhile, Texas Instruments' semiconductor operations continue to run at a loss.

Cypress's own legal history illustrates how absurd these skirmishes have become. When we entered the RISC microprocessor market we needed a technology manager. After an introduction from a venture capitalist, we hired a well-known computer expert, and played venture capitalist for his RISC company. When he and the four other founders of Ross Technology left Motorola they were immediately sued--both as a corporation and individually. All of Ross's employees were directly threatened with not being able to work for another company on microprocessors--the foundation of their careers.

The Motorola lawsuit was a typical warning shot fired across our bow. We settled the suit in the usual way, with no money changing hands and an agreement not to disclose the terms of the settlement. Then came a truly absurd development. Ross Technology hired *one* engineer from Advanced Micro Devices. AMD sued us and him personally. Fortunately, it turned out that AMD's lawyers made an embarrassing blunder that I call "Xerox litigation." The lawyers had simply taken the Motorola lawsuit, which named five defendants, removed their names, inserted the name of the engineer hired from AMD, and then re-filed the lawsuit with minimal cost. AMD literally copied the Motorola lawsuit--and did not even have the plagiaristic precision to change the plural to the singular! Naturally, they did not prevail and we kept our engineer.

Unfortunately, these stories are typical of the legal realities of life in our business. In more than 25 actual or threatened lawsuits we have never lost a case or paid a cent to a plaintiff. Are Cypress's lawyers that good or are we being harassed with nuisance litigation?

Earlier this year semiconductor litigation took a new and bizarre twist. Sematech actually sued the government of Travis County, Texas, in an effort to exempt itself from the local schools tax by claiming that it was a "charity." Sematech hired one of the leading law firms in Houston

and paid hundreds of dollars per hour for its legal ammunition. Ultimately, Sematech withdrew the suit just as it was about to go to trial and agreed to pay its fair share of the schools and roads its employees use. The situation is absurd: The federal government paying to sue a local government to reduce funding for education. Is this really how Congress intended to "assist" the semiconductor industry?

I would like to offer two suggestions on litigation. First, Congress should be wary about high-minded talk of "protecting intellectual property." Such talk is usually a codeword for more harassing lawsuits. Second, Congress should pass legislation that requires plaintiffs to pay the legal fees of defendants in lawsuits in failed intellectual-property lawsuits. It may not be possible to end the litigation wars, but it is possible to make frivolous skirmishes less appealing to the aggressors' profit-and-loss statement.

The United States is the best country in the world in which to start a semiconductor company. There are problems, to be sure, but they can be addressed by common-sense improvements to our system, a few of which have been suggested here. The U.S. semiconductor industry's period of market-share loss ended years ago. We gained back share last year. Every failing CEO who uses America as an excuse supplies to his or her entire organization a clear leadership message that failure is tolerable or even expected. That is a message no organization can afford to hear.

Mr. BROWN. Thank you very much, Dr. Rodgers, that was a very provocative statement.

And now Dr. Yoshio Nishi, who is Director of the R&D Center, Integrated Circuits Business Division for Hewlett-Packard in Palo Alto.

Dr. Nishi?

STATEMENT OF YOSHIO NISHI, DIRECTOR, INTEGRATED CIRCUITS BUSINESS DIVISION RESEARCH AND DEVELOPMENT CENTER, HEWLETT- PACKARD, PALO ALTO, CALIFORNIA

Dr. NISHI. Thank you, Mr. Chairman, members of the subcommittee, good morning. I am very honored to be here to address the effectiveness and working mechanism of semiconductor consortia in Japan, based on my experience of working in the U.S. and Japan which included those kind of involvements.

Before starting my presentation I'd like to make clear that I am testifying as an individual and I am not representing Hewlett-Packard Company at this moment, also I attached the workshop report an appendix which might provide some useful background materials, however the workshop report is not the official views of the National Academy of Science or the National Research Council.

I'd like to ask you to open to page four of my materials. After coming to this country, I have been trained to use overhead viewer a lot. I found out that doesn't work here, however I have the set of pictures which should be helpful you to clearly understand what I like to say in my poor english.

This page has three typical Japanese consortia activities. One is the VLSI Program which was four years from 1976, and the next one is Future Electron Devices Program which was 10 years from 1981, the last one was the High Temperature Superconductivity Program. And my point here is that starting from the VLSI program there has been fairly significant change in the character of Japanese consortia activities.

The first one, namely the VLSI Program, was the first trial in forming collaborative research activity with a centralized research site. And the next one is a different form of the VLSI Program in terms of not having a centralized research site, and there was one organization called Research Association for Future Electron Devices but it worked just as a coordinating organization. The last one is rather different from the previous two because the central theme of this Program is international participation.

Now, please move to the next page, the VLSI Program. The genera! attitude of industry researchers toward the consortia activity in 1976 was quite skeptical and also some people felt quite scary because of their concerns like how to make it work and also there was a tremendous nervousness about the VLSI Program itself and also there was a lot of confusion about why they need that. And after finishing the program, what they found out was it's workable and also good value in sharing viewpoints on future technology and foundation for collaboration in precompetitive areas, the importance of holding long term strategy with stable R&D funding. Still, there are several questions like what about a clear path for the

people involved in collaborative research lab in Japanese environment, and also the first one strictly excluded foreign visitors from any part of the activity.

And the next page is visually showing how the overall structure looked like. The NEC and Toshiba created NTIS Lab and Fujitsu, Hitachi, and Mitsubishi created the CD Lab. By the way, those two labs already existed before the MITI VLSI Program as joint computer research activity, and there was one central lab which was called VLSI Cooperative Lab which consists of those five companies' researchers, and also some university faculty and Government lab people. And the goal was to develop the technology by which they can commercialize the one megabit DRAM in 1985. To make that happen, the original goal was that one-micron device technology and sub-micron process technology and there are a lot of test vehicles and 64K bit experimental sample or prototype or one of those kind of vehicles.

Then the next page, please, the Future Electron Devices Program. A certain paradigm would change in Japanese consortia, beyond this program. One is they decided not to do cooperatively such lab and also they wanted to invite more university and Government lab participation and there was some concern about coordination through MITI subsidy.

And once it started there was several good things and also some concerns left. One is foundation for industry- university collaboration, especially in superlattice and three dimensional integration projects. That has been fairly successfully finished, and some new discoveries such as resonant tunneling devices, but mostly steady, long-range, patient research. And the member companies found out that this program is less of a financial burden to the companies and since this was a 10-year long program, therefore there are a lot of sharing long-range technology vision, and also there was an open invitation to foreign scientists to attend review meetings which were held once in every year.

Then the third area was high temperature superconductivity started in 1988. That was another paradigm change influenced by a new wave of inviting international participation, and it was a stand-alone organization which has a complete set of functions, still jointly funded by industry and Government; and a much larger range of industrial participation; and consortia, just one of the usual businesses; and closer collaboration among a diversified range of people.

Now I'd like to point out two important things which existed behind those consortia activity. One is roles of leading university professors in Japan. They coordinate and share a meeting with industry technology leaders such as directors of research laboratories because they are supposed to be quite neutral; and also initiate communications between MITI and industry for long-term research; and identify areas of importance with industry technology leaders; and there are several other things which I wrote down here.

And the other important factor in Japanese consortia activity was that researchers and engineers in industry, universities and MITI laboratories have the same level of education and quality and industry consists of a handful of companies of similar size and busi-

ness territory with basic research laboratories. And also the seniority system eventually encourages smoother inter-company people interaction; and industry research laboratories are not in competition with university research laboratories; and it is much easier to maintain stable R&D funding once committed to consortia/MITI contract research.

By skipping the next page, I'd like to go to the summary. Japanese consortia activities have provided long-term goal setting, formation of R&D methodology, stable funding for long-term R&D, cultivation of new culture in which industries can communicate bilaterally at several levels of organizational hierarchy in precompetitive phases and of course, there was generic nature of consortia benefit which is risk reduction in key technology areas and also easier focus in manufacturing once R&D strategy is stabilized.

I'd like to mention the last point. After observing those kinds of activities and also internal mechanisms, the real value in the case of Japanese consortia seems to be in preparing the infrastructure, or the soil, from which you expect-a greater harvest after you plant the seed of your choice.

Thank you for your attention.

[The prepared statement of Dr. Nishi follows:]

SEMICONDUCTOR R&D CONSORTIA IN JAPAN

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Introduction

It has been well accepted that the first R&D consortium activity in the field of integrated circuit technology in Japan was the MITI VLSI Program from 1976-1979. Since then there have been several consortia activities in semiconductor and related areas.

Before discussing those activities, roles and working mechanisms, I would like to quickly review a history of DRAM technology, which is well-known as a "technology driver."

Since 1971 DRAM memory bit capacity has increased by 4X every two years (Moore's Law). From 1Kbit to 16Kbit, it was achieved by a combination of process technology evolution and design cleverness, such as reduction of transistors per bit from 3 to 1. 64Kbit DRAM, known as the first chip of the VLSI era, introduced in 1979 (R&D) and 1981 (product), changed the paradigm from "process technology and circuit cleverness-driven" to "process technology especially lithography-driven." Since then, DRAM has driven VLSI technology, which is significantly equipment intensive; in other words, capital intensive.

Now let's consider the role of DRAM as a technology driver. DRAM has eventually served as the most sensitive sensor for any failures in materials, processing, equipment throughout its performance, yield and reliability. Examples are as follows:

a. Performance
   - -- speed: minimum lithographic resolution and critical dimensional control in areas such as sense amplifier design.
   - -- density: minimum geometry

b. Yield
   - -- defect density control during processing
   - -- impurity contamination in starting materials and processing materials such as chemicals and gases
   - -- yield learning because of very high manufacturing volume
   - -- introduction of automatic wafer handling and concept of factory automation in IC environment

c. Reliability
   - -- α-ray soft error investigation for DRAM prompted ultra-pure processing materials and packaging materials
   - -- purification of starting materials

Another important aspect of DRAM is as a contributor to business growth. DRAM occupies nearly 30% of VLSI manufacturing volume. However, design engineering resources needed to develop one family of DRAMs in one technology generation is significantly small (1/10) compared to those needed in, for example, microprocessors. This leads to a structure where fewer R&D resources (excluding equipment-related resources and investment) can generate huge revenue with only one or two process variations in manufacturing plant, if one can afford manufacturing capital investment of a minimum critical size, and also if one does not miss the exact window for product introduction. ROI is excellent in a good business environment, and even in a bad environment, DRAM has absorbed the basic cost of running a state-of-the-art fab. Manufacturers who had DRAMs in their product lines greatly benefited from the scale merit of manufacturing. Also, it was easier to expand their revenue base, which has allowed them to sustain a high level of R&D investment. This created a positive feedback loop toward growth; namely larger R&D, followed by highly competitive products leading to growth of revenue, which justifies an even larger R&D investment.

Another question might be, "What if we did not have DRAMs?" It is obvious that VLSI industry growth could have been much slower, and the size of industry would have been a couple of orders of magnitude smaller than we have today. Some of the technology could have been developed without delay, but the progress would not have been straightforward, because of the possible lack of Moore's Law as a guiding trend. In short, the nature of business could have been "technology-driven" rather than "trend-driven." The progress of computers, workstations and personal computers would have been much slower, and the industrial infrastructure would have been far more fragile.

Role of the MITI VLSI Program

As I mentioned earlier, there was clearly a "turning point" or a "technical paradigm change" when VLSI technology started. The MITI VLSI program sat in the middle of the period of paradigm change, and contributed to it.

The Program was started in 1976, when the VLSI Cooperative Research Laboratory was established as a central research organization with five member companies: Hitachi, Fujitsu, Mitsubishi, NEC and Toshiba. These companies sent researchers and managers to the VLSI Cooperative Laboratory. People also came from the Electrotechnical Laboratory (a national lab). At the same time, they established laboratories at their own sites, called the "CD Lab" by Hitachi, Fujitsu and Mitsubishi and the "NTIS Lab" by NEC and Toshiba. Approximately 40% of the total amount of money spent during the four-year period came from by MITI and the rest of the expenses were paid by the member companies' headquarters.

Since it was the first experience for the integrated circuits industry with having a consortium, many people involved had serious concerns about how to make it work, how successful it could be and also, why it was needed.

After going through this period, people started to recognize that it was workable, and had great value in sharing viewpoints on future technology. They also learned a way to share technical information in precompetitive areas, even with competitors in current products, as well as the importance of having a long-term strategy with stable R&D funding/spending. Certain concerns still remained as to whether it would be a good career path for people involved in Cooperative Research Laboratory activities in a traditional Japanese environment.

I recently talked with several R&D executives in Japan (who had been involved in the Program directly or indirectly) about their views on the value and role of this consortium in the Japanese semiconductor industry, as well as the Future Electron Devices consortium and also other consortia such as X-ray Lithography and Fifth Generation Computers, in the Japanese semiconductor industry.

Most of them independently made the following comments and observations, in addition to listing generic advantages and disadvantages of consortia activities, such as risk reduction, cost sharing, and elimination of overlap.

o Most Japanese consortia failed to achieve originally-stated goals, including even the famous MITI VLSI program, if one had had to measure the success rigorously, based upon a defined set of objectives.

o However, consortia activities enabled companies to buy additional equipment needed to conduct R&D, which contributed tremendously to technology commercialization after the consortia ended. Cash flow in consortia from government to the equipment industry through the chip manufacturing industry strengthened the equipment industry infrastructure. For instance, without consortia money, the R&D organization of member companies would not have been able to afford domestically-made equipment for characterization and improvement, because their generic R&D budget before consortia was too tight for them to afford it. One good example was the Nikon steppers, which were developed and improved through the MITI VLSI program.

o A culture for long-term stable R&D was developed, which helped them recover from the 1985-1987 slump when they did not decrease R&D spending, even in an environment where they had to cut all of their third level and above managers' bonuses and salaries by 5%.

o Successful consortia goals were generally set so that member companies wanted to pursue them, whether consortia were created or not. From this viewpoint, a successful example was the VLSI program; an unsuccessful one was SOR X-ray lithography, SORTEC.

o Appreciation of consortia management where formal review meetings were held once annually, giving member companies the flexibility to pursue a goal differently, with various spin-off activities.

o Commitment to consortia forced member companies to increase resources, which later contributed to R&D and productization.

o People-networking across the technology areas of interest was significantly improved, which has laid the groundwork for more cooperation and collaboration in the future, when critical resource levels will be much higher than today. In short, the real value of consortia seems to be in preparing the infrastructure, or the "soil," from which you expect a greater harvest after you plant the seeds of your choice.

VLSI Program (4 years from 1976)

The first trial in forming collaborative research activity with a centralized research site

Future Electron Devices Program (10 years from 1981)

Different from the VLSI program in terms of not having a centralized research site
Research & Development Association for Future Electron Devices as a coordinating organization

High Temperature Superconductivity Program

International Superconductivity Technology Center as a centralized research institution open to international participation

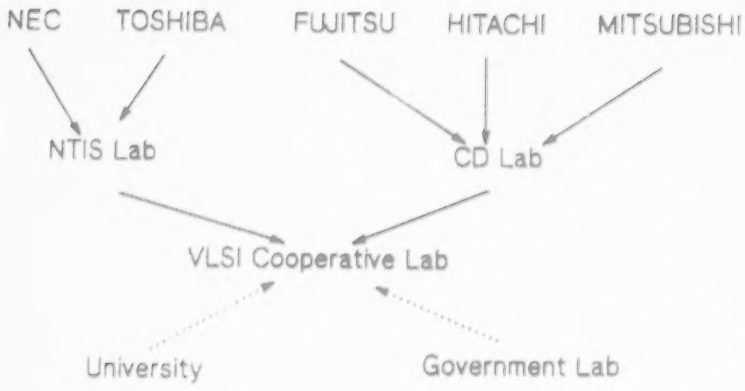
VLSI Program

General attitude of industry researchers/engineers toward consortia activity:

--many concerns about how to make it work
--nervousness about VLSI program
--confusion about why we need this

--it is workable
--good value in sharing viewpoints on future technology
--foundation for collaboration in precompetitive areas
--importance of holding long-term strategy with stable R&D funding
--questions as to whether it can be a good career path for people involved in Cooperative Research Laboratory activity
--strictly excludes foreign visitors from any part of the activity

MITI VLSI Program (1976–1979) 280 M$ (1¥ = 250¥ in 1976.)



- o one micron device technology
- o sub-micron process technology
- o 64k bit dynamic memory as one of test vehicles

Future Electron Devices Program

--too busy and limited in resources to form cooperative research laboratory or its equivalent

--question of inviting more university and government lab participation

--concern about coordination through MITI subsidy

--foundation for industry-university collaboration, especially in superlattice and 3D integration projects

--some new discoveries, such as resonant tunneling devices, but mostly steady, long-range, patient research

--less financial burden on member companies

--sharing long-range technology vision

--open invitation to foreign scientists to attend review meetings

High Temperature Superconductivity (1988)

--influenced by a new wave of inviting international participation

--stand-alone organization which has a complete set of functions, still jointly funded by industry and government

--much larger range of industrial participation

--consortia, just one of the usual businesses

--closer collaboration among a diversified range of people

Roles of leading university professors:

--coordinate/chair a meeting with industry technology leaders such as directors of research laboratories

--initiate communications between MITI and industry for long-term research

--identify areas of importance with industry technology leaders

--help MITI technocrats with planning

--create advisory board once program starts

--part of review board in a progress review

--neutral, but highly respected by both MITI and industry

What are the facts supporting consortia activity?

--researchers/engineers in inudstry, universities and MITI laboratories have the same levels of education and quality

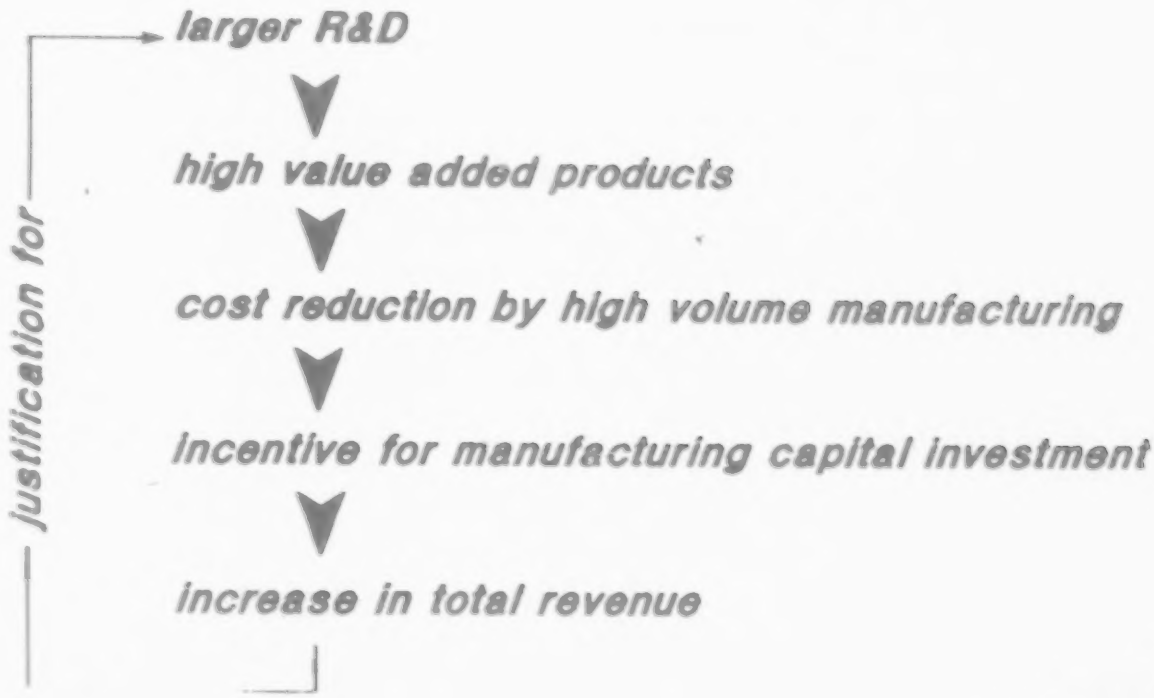
--industry consists of a handful of companies of similar size and business territory with basic research laboratories

--seniority system eventually encourages smoother inter-company people interaction

--industry research laboratories are not in competition with university research laboratories

--it is much easier to maintain stable R&D funding once committed to consortia/MITI contract research

High technology industry: non-steady state solution under growing market situation



SUMMARY

Japanese consortia activities have provided:

--long-term goal setting

--formation of R&D methodology

--stable funding for long-term R&D

--cultivation of new culture in which industries can communicate bilaterally at several levels of organizational hierarchy in precompetitive phase

--risk reduction in key technology areas

--easier focus in manufacturing once R&D strategy is stabilized

Mr. BROWN. Thank you very much, Dr. Nishi. That's extremely helpful to us.

And now Jerry Rogers, President and CEO of Cyrix.

STATEMENT OF JERRY ROGERS, PRESIDENT AND CHIEF EXECUTIVE OFFICER, CYRIX CORPORATION

Mr. ROGERS. Mr. Chairman, thank you for this opportunity to speak out on an issue vital to American competitiveness. My name is Jerry Rogers and I am President and Chief Executive Officer of Cyrix Corporation which designs high performance micro-processors, the brains for the personal computer.

The U.S. semiconductor industry has been characterized for over 30 years by its innovative venture companies. In the 1950s Texas Instruments, Motorola, and Fairchild began discrete business ventures. In the 1960s, National, Signetics, and Advance Micro Devices were initiated as bipolar, integrated circuit business ventures. In the late 1960s, Intel was initiated as a MOS integrated circuit venture. These waves of new venture companies have continued to the present time and without them the U.S. semiconductor industry would never have achieved its place of significance in the world market.

Today, Cyrix represents the latest of these new waves of new ventures, the so-called "fabless" semiconductor industry. These are companies that contract manufacturing of their chip designs to other firms. The fabless companies are at the leading edge of advances in product design and are a driving force in insuring the competitiveness of the U.S. semiconductor industry.

Though fabless companies are typically small, entrepreneurial start-ups, they already account for 10 percent or nearly 10 percent of the U.S. semiconductor sales. We welcome any action consistent with the philosophy of free enterprise that further strengthens the competitiveness of companies in this sector. Today I have been asked to respond to several issues including the question, is Sematech contributing to the competitive viability of the U.S. semiconductor industry. From the standpoint of firms like Cyrix, the answer is not as much as it ought to be. Most often we must look to far eastern manufacturers to provide the capabilities most essential to compete in the world market: rapid prototype cycle time, state-of-the-art manufacturing, and consistent support over a long period of time, particularly for quality, delivery and cost even though our volumes are typically small.

The majority of the large U.S. manufacturers will not provide contract manufacturing services and those few firms who will support contract manufacturing are not competitive on prototype response nor are they willing to commit to near state-of-the-art manufacturing. These companies are representative of the Sematech members. From this assessment I can only conclude that Sematech and its members are not supporting this new, innovative arm of the U.S. industry as represented by the fabless, integrated circuit firms. In fact, one of Sematech's members, Intel, has taken such a strong anti-competitive stance toward us that we have been forced to file anti-trust suits in Federal and Texas State Courts and there

are recent reports that the FDC is looking into their business practices.

But I did not come here to dwell on negatives. Instead I'd like to zero in on some issues I think are important for securing our long-term competitiveness. Congress should act to insure all U.S. semiconductor firms, not just a favored few, benefit from tax supported research conducted by consortia like Sematech.

If an industry consortium receives a meaningful portion of Government funding to the semiconductor industry, shouldn't the direct beneficiaries be required to provide access to this technology to all U.S. firms on competitive terms? And for technology which is protected by patents, shouldn't timely and reasonable licensing be a requirement?

Another vital element to the continued competitiveness of the semiconductor industry is patent protection that encourages innovation and does not stifle it. I'd like to discuss some particular areas of concern to the technology innovators like Cyrix.

Far too often patents are issued that reflect marginal advances in technology or a similar implementation of an existing manufacturing process or product—in essence, a new frame on an old print. Too often, patent examiners—underpaid and overworked—are overwhelmed by high powered, high paid lawyers representing large corporations seeking patents on questionable "inventions". Unfortunately this type of patent can be used by large corporations to intimidate small firms.

Patent licensing for manufacturing processes represents a significant challenge to venture companies. Consider a typical manufacturing process used today where each of the large U.S. manufacturers owns specific patents for one or more steps in the fabrication process. Innovation sometimes depends on access to these "patent pools"—that is, the licensing of multiple items of intellectual property that are interrelated but whose patents are held by various parties. Established companies having substantial patent portfolios can often swap their patent rights to gain access to these patent pools.

Smaller companies, however, possess innovative intellectual property of very high value. It's just that they have not had time to obtain patent rights to this property. Therefore, they have fewer patents with which they can barter. For this reason, smaller companies face stark alternatives: One, they can pay 10 to 20 percent royalty to each patent holder in the pool, as you can see this quickly adds up to a prohibitive cost. Number two, they can trade product rights for processing rights to gain market entry. In other words, they must turn the rights of all of their intellectual property and products over to these larger manufacturers in order to gain market entry. If today's large manufacturers had to face these alternatives when they were small ventures, the U.S. semiconductor industry would not have achieved its current status in the world market.

Valid patent protection is, of course, essential to the integrity of every high-tech industry. I'm not calling for fewer patent laws or for that matter, more patent laws, I am underscoring the impact of these issues. I understand and hope that the Special Advisory Commission on Patent Law Reform will address these critical issues.

All of these issues I have discussed today were not present 30 years ago when today's large firms were small ventures. If these practices were present then, few of these firms would have survived. My comments to you underscore that the U.S. semiconductor industry was made and grew into strength of the basis of small innovative ventures, and that the new issues which have emerged should not be allowed to close off this productive arm of the industry.

In concluding I'd like to reiterate my pride in the contributions that have been made to American's competitiveness by Cyrix and all the entrepreneurial companies like us. If we can be assured a level playing field that gives us the same access to tax-supported research that larger companies enjoy, and if we can be assured of protection, not victimization by the Nation's patent laws, I am sure that we can make an even more substantial contribution to the Nation's competitive strength in the years ahead. Thank you.

[The prepared statement of Mr. Rogers follows.]

Written Testimony
By Jerry Rogers
President and Chief Executive Officer
Cyrix Corporation

Before the
U.S. House of Representatives
Subcommittee on Technology and Competitiveness
July 23, 1991

Mr. Chairman:

Thank you for this opportunity to provide testimony on an issue vital to American competitiveness.

My name is Jerry Rogers, and I am President and Chief Executive Officer of Cyrix Corporation, which was founded in 1988 and is based in Richardson, Texas. Cyrix designs high-performance microprocessors -- the "brains" of personal computers. We take particular pride in our FasMath™ coprocessor -- the fastest, most accurate and most power-efficient math coprocessor for personal computers available anywhere. FasMath captured fully 20 percent of the math coprocessor market within just a year of its introduction.

The U.S. semiconductor industry has been characterized for over 30 years by its innovative venture companies. Today it is almost entirely comprised of companies that began their semiconductor operations either as new ventures or as a venture project for a relatively small firm. In the 1950's, Texas Instruments, Motorola and Fairchild began discrete products business ventures; in the 1960's, National, Signetics and AMD were initiated as bipolar integrated circuit ventures; and in the late 1960's, Intel was initiated as a metal oxide semiconductor (MOS) venture. These waves of new venture companies have continued to the present time. Without these

innovative ventures, the U.S. semiconductor industry would never have achieved its place of significance in the worldwide market.

Today, Cyrix represents the latest in these waves of new ventures. Cyrix is providing new architectural solutions for standard processing functions. Our original product designs stress compatibility with the large installed base of software for PCs and workstations, and add extensions to provide new and unique utility to users.

The competitive strength of Cyrix lies in our knowledge of systems, integrated circuit design and the selected user's software applications. In addition, using a strong base of the latest computer-aided design tools and workstations, we have the capability to produce very large and complex integrated circuits.

These are the particular capabilities we build on:

- Timely and creative coupling of system and integrated circuit design skills and a thorough understanding of users' need for high performance workstations;
- Extensive use of computer software and hardware to define new products and get them to market quickly;
- Utilization of manufacturing subcontractors that employ near state-of-the-art processes and can deliver prototypes rapidly; and
- Extensive product testing, using automatic equipment, to ensure that quality requirements are being met.

In terms of our capital allocation, Cyrix's greatest continuing need is to invest in computer-aided design tools. Almost 40 percent of our start-up costs in 1988 went toward this end, and we invested another $2.5 million in 1990 to upgrade our capability. We anticipate that we will have to double our total investment in design tools every few years to stay competitive. Since our future depends so much on

this design technology, we consider it fortunate that U.S. vendors still have solid leadership in the field.

Being a "fabless" company -- a firm that subcontracts all its product fabrication -- Cyrix is in the vanguard of an industry trend that began in the early 1980's. At that time, fabrication facilities for high volume, large-scale integrated generic parts, such as memories, were becoming larger and more capital-intensive -- beyond the reach of most small ventures. The solution was to find semiconductor manufacturers able to execute contract work on a fast turnaround basis.

Though fabless companies like Cyrix are typically small, entrepreneurial start-ups, they already account for nearly 10 percent of total U.S. semiconductor sales.[1] Their number has grown as the capital requirements for establishing and operating high volume fabrication facilities has risen beyond the reach of most small ventures.

The fabless companies are at the leading edge of advances in semiconductor design and are a driving force in ensuring the competitiveness of the U.S. semiconductor industry. The strong performance of these entrepreneurial, design-rich firms is truly an American success story, and Cyrix is proud to be part of it. We welcome any action, consistent with the philosophy of free enterprise, that further strengthens the competitiveness of companies in our sector.

Today, I have been asked to respond to several issues including the question: Is Sematech contributing to the competitive viability of the U.S. semiconductor industry?

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[1] Montgomery Securities, Tom Thornhill

From the standpoint of firms like Cyrix, the answer is: not as much as it ought to be. The 1987 Congressional Budget Office report on *Benefits and Risks of Federal Funding for Sematech* contains glowing words on Sematech's potential to revitalize U.S. chip manufacturing and benefit the entire semiconductor industry. But for the fabless sector of the industry, Sematech hasn't yet lived up to its promise.

Cyrix, for example, devotes a sizable effort to a continuing search, evaluation, and monitoring of contract manufacturing firms. And most often, we must look to Far Eastern manufacturers to provide the capabilities most essential for our continued competitiveness. These include:

- Rapid prototype cycle time.- We are targeting less than a month from release of computer data bases defining the design to initial receipt of prototypes.
- Near state-of-the-art manufacturing. Our products feature the highest performance levels.
- Consistent support over a long period of time, particularly for quality, delivery and cost -- even though our wafer volumes are relatively small. Most contract manufacturers' priorities and support will shift as their own internal needs change.
- Licensed manufacturers for their processing and manufacturing technology to avoid potential interference suits at some later date by third parties.

The majority of the large U.S. manufacturers will not provide contract manufacturing services, and those few firms who will support contract manufacturing are not competitive on prototype response, nor are they willing to commit to near state-of-the-art manufacturing availability. Their record of consistency of support over a period of

time is also suspect. These companies are representative of the Sematech members.

From this assessment I can only conclude that Sematech and its members are not supporting this new, innovative arm of the U.S. industry as represented by the "fabless" integrated circuit firms. In fact, one of Sematech's members -- Intel -- has taken such a strong anticompetitive stance toward us that we have been forced to file anti-trust suits in federal and Texas state courts, and there are recent reports that the FTC is looking into Intel's business practices.

But I did not come here to dwell on negatives. Instead, I would like to zero in on the elements most important to the continuing competitiveness of the emerging, design-rich semiconductor companies and identify ways that the government can aid in securing them.

A vital element to this continuing competitiveness is one that Congress can take direct action on. That is, Congress should act to ensure that all U.S. semiconductor firms -- not just a favored few -- benefit from tax-supported research conducted by consortia like Sematech.

If an industry consortium receives a meaningful portion of government funding to the semiconductor industry, shouldn't the direct beneficiaries be required to provide access to this technology to all U.S. firms on competitive terms? And for technology which is protected by patents, shouldn't timely and reasonable licensing be a requirement?

Another vital element to the continued competitiveness of the semiconductor industry is patent protection that encourages innovation and does not stifle it. I'd like to point out some particular areas of concern to the technology innovators like Cyrix.

Far too often patents are issued that reflect marginal advances in technology or a similar implementation of existing manufacturing process or product -- in essence, a new frame on an old print. Too often, patent examiners -- underpaid and overworked -- are overwhelmed by high powered, high paid lawyers representing large corporations seeking patents on questionable "inventions". Unfortunately, this type of patent can be used by large corporations to intimidate small firms.

Patents may lay dormant in the patent office for 10 to 15 years only to be reactivated by the patent holder through a reissue process. The reissue process allows the patent holder, in essence, to redefine his patent to cover current technology or product ideas. This process, when abused, allows larger corporations with the financial resources to continually prosecute patents to financially muscle small ventures out of the market.

Patent licensing for manufacturing processes represents a significant challenge to venture companies. Consider a typical manufacturing process used today where each of the large U.S. manufacturers owns specific patents for one or more steps in the fabrication process. Innovation sometimes depends on access to these "patent pools" -- that is, the licensing of multiple items of intellectual property that are interrelated but whose patents are held by various parties. Established companies having substantial patent portfolios can often swap their patent rights to gain access to these patent pools.

Smaller companies, however, possess innovative intellectual property of very high value. It's just that they usually have not had time to obtain patent rights to this property. Therefore, they have fewer patents with which they can barter. For this reason, smaller companies face stark alternatives:

- One, they can pay a 10-20 percent royalty to each patent holder in the pool, which can quickly add up to a prohibitive cost; or
- Two, they can trade product rights for processing to gain market entry. In other words, they must turn over the rights to all their innovative intellectual property and products to the larger manufacturers before they are granted manufacturing processing in return. This is a very high price to pay to enter the market.

If today's large manufacturers had to face these alternatives when they were small ventures, the U.S. semiconductor industry would not have achieved its current place of significance in the world market.

Valid patent protection is, of course, essential to the integrity of every high-tech industry. I am not calling for fewer patent laws or, for that matter, more patent laws. I am underscoring the impact and the urgency of these issues. I understand and hope that the Special Advisory Commission on Patent Law Reform will address these critical issues.

All of the issues I have discussed today were not present 30 years ago when today's large firms were small ventures. If these practices were present then, few of these firms would have survived. My comments to you underscore that the U.S. semiconductor industry was made and grew into strength on the basis of small innovative ventures, and that the new issues which have emerged should not be allowed to close off this productive arm of the industry.

In concluding, I would like to reiterate my pride in the contributions that have been made to America's competitiveness by Cyrix and all the entrepreneurial companies like us. If we can be assured a level playing field that gives us the same access to tax-

supported research that larger companies enjoy, and if we can be assured of protection -- not victimization -- by the nation's patent laws, I am sure that we can make an even more substantial contribution to the nation's competitive strength in the years ahead.

Thank you.

Biography
of Jerry Rogers
President and Chief Executive Officer
Cyrix Corporation

Before the
U.S. House of Representatives
Subcommittee on Technology and Competitiveness
July 23, 1991

Jerry Rogers is president and chief executive officer of the company. After leading the company to capture 20% of the math coprocessor market in only its first year of sales, he was named in June 1991 as regional "Entrepreneur of the Year," in an explosive growth category.

Before starting Cyrix, Rogers was vice president of Texas Instruments' Microprocessor Division, responsible for microprocessor, DSP graphics, and token ring products. In this position, Rogers helped Texas Instruments gain a 60% market share for digital signal processing, or DSP, and established the company as a dominant force in graphics for second generation PC's and in token ring technology. Rogers had responsibility for design, marketing and manufacturing for a wide range of products, and supervised over 4,000 people located in six facilities worldwide. He gained industry recognition for product leadership in the areas of digital signal processing and graphics. His innovative work resulted in 14 patents for chips and systems.

Rogers holds a bachelor's degree in computer science from the University of Houston.

Mr. BROWN. Thank you very much, Mr. Rogers.

And now our last panelist is Dr. William Spencer who is President and CEO of Sematech.

STATEMENT OF WILLIAM SPENCER, PRESIDENT AND CEO, SEMATECH, AUSTIN, TEXAS

Dr. SPENCER. Good morning, Mr. Chairman and thank you for inviting me to testify before this subcommittee, a subcommittee charged with technology and competitiveness which, as a parochial technologist, I believe is one of the key issues facing the Nation today. In addition to inviting such a stimulating panel discussing what I think are a series of important questions.

About eight months ago, consortia became a much bigger part of my life when I succeeded Bob Noyce as CEO and President of Sematech. I took that job because I believe that Sematech represents the most important experiment in collaboration in the Nation today. I am pleased to report after having been there eight months that Sematech is making great progress in finding ways for fierce competitors to work together for common good in an environment of precompetitive cooperation.

By focusing our effort on precompetitive research and development and by focusing on manufacturing in the semiconductor area and by bringing Government and industry and academia to bear on this problem, I think we've made good progress.

As many of the other panelists have pointed out, semiconductors are a uniquely American industry. They were invented here, we opened the market, we pioneered them and you can argue whether we have lost leadership in that, but our position in the market has degraded severely over the past decade. They are important to us from a defense standpoint and they are equally important to us as an economic position. The importance in defense was, I think, shown very clearly in the recent Desert Storm Operation where high tech weapons provided a major advantage to our armed forces.

Now I believe they are equally important to our national economic security. We are entering a time of the information age. As we enter the 21st Century the main tender for business is going to be information and those nations who have an ability to compete in the electronics area, which is underlaid by the semiconductor industry, are going to be the leading nations of the world.

In 1987, the Defense Science Board, along with a number of industry leaders, recognized that there were a number of problems in the semiconductor industry and Sematech was formed at that time. Sematech was not intended to be a Japanese solution to our problem nor a European solution to our problem, but a uniquely American solution.

While I believe that Sematech is going to achieve the goals that it set for itself when it started in 1987, by 1992 we are not going to solve all of the problems that faced the industry at this time. Sematech does represent 14 companies in the United States which represent over 80 percent of the semiconductor business today. And by all comparisons to what's going on in Japan and Europe, Sematech represents a very modest experiment but I think it has tre-

mendous implications not only for us in the semiconductor industry but for all American industries.

Our mission is relatively simple, we want to provide the U.S. semiconductor industry the domestic capability for world leadership in manufacturing. We want them to have the infrastructure capable to allow them to be leaders in the global market. Sematech provides a forum for communication and coordination of efforts in a large number of organizations in the United States. We have 27 different universities in 11 different states working in our Sematech Centers of Excellence. That program is managed and coordinated with SRC. Semiconductor equipment supplier community is involved through our Joint Development and Equipment Improvement programs. We try to involve the national laboratories by bringing their expertise in reliability and modeling to bear on the development of equipment for infrastructure for the U.S. semiconductor manufacturing area.

People from 14 companies can work together if the issues are properly defined. At Sematech these issues are free competitive tools and the associated unit processes, materials, manufacturing systems and methods. This is opposed to getting involved in competitive or specific commercial products and specific commercial processes. Sematech does not have a role in assembling complete commercial products or fabrication processes. I believe consortia, as represented by Sematech, have several advantages. First in the case of Sematech, it's an industry-driven consortia, the mission has been set by industry and it is managed by industry. There has been a one to one sharing on the cost of that by Government and industry. Second, as center for manufacturing technology research we can focus our resources, we think, for a maximum impact.

And perhaps the best example is in ones that have been raised earlier here today is that we can provide a single qualification for 14 member companies to an equipment manufacturer. There is a single interface for that equipment manufacturer and a single qualification for 14 member companies. And in some cases when that qualification is done at a member company's site, and we have done more of that recently than we had when Sematech started, dollars flow back to member companies because they have real costs in providing an asset to all 14 member companies. And since we are trying to establish global market leaders in the equipment manufacturers and the United States is no longer the largest purchaser of integrated circuits or the largest manufacturer of integrated circuits, these companies have to sell into global markets. So we have encouraged our equipment manufacturers to develop world class equipment which they sell to every one the United States and foreign semiconductor manufacturers as well. They've got to do that if they are going to be market leaders.

Third, I think by pioneering research and development and sharing a place for the exchange of knowledge and ideas for all of these participants' research and development and sharing our knowledge with our members, we can maximize the member investment. We have the luxury at Sematech of following high risk, high pay-off research projects. Usually no company can do that on their own and, of course, the consortia can.

Fourth, and perhaps one of the most important point is I think we have offered a forum for open communication that didn't exist before Sematech was founded. Universities and professional societies have not provided that sort of environment and I've seen it in operation at a number of meetings at Sematech since I've been there.

Finally, we've developed with our member companies and with the supplier community a quality program which we think will be a benchmark for the suppliers and equipment manufacturers to work together. Now one of the key questions that you are raising today is whether or not public funds should be used in a consortium like Sematech. I think there are a number of reasons for the Government being involved in that over and above the reasons that were discussed this morning. Mr. Pickle's testimony was about the Government being the largest—one of the largest customers of the output of the R&D at Sematech.

For the Government it's a good investment, a good leverage on their R&D dollars. For every dollar the Government spends at Sematech it's matched by one dollar of private funding. In turn, when we invest that in equipment suppliers, it's usually matched between one and three times by the equipment manufacturer and their R&D dollars. The total investment from the private side, by the way, in 1990 was about $4.5 to $5 billion in R&D, so the Government gets at least a three to one leverage of the dollars and in some cases as much as five or six to one. I also believe that the investment is good for the Government because if we can retain or regain one percentage point in market share, it represents something like 3,000 jobs in the United States.

Now the Government investment has always been deemed appropriate for generic research whether it's in agriculture, aerospace, basic science, or in semiconductors. I believe that the Government should invest in consortia because we're competing with regions in our global markets in which there is collaboration between Government and industry. This was pointed out very strongly by the Computer Systems Policy Project (CSPP) not long ago and this is nowhere more apparent than in Europe today.

If you read the New York Times story about three weeks ago about the impact of the Airbus consortia on market share in commercial aircraft, you know that Europe is in this for the long haul. That consortia has been together for 21 years, has represented over $25 billion in investment from government sources and today is making major gains in market share. And Dr. Nishi has described what's gone on in Japan where they have had great success with consortia.

Let me give you a couple of examples, or one example where Sematech has made a difference in a small company. We invested in Ateq, a company that makes equipment to build masks for semiconductor manufacturing in Beaverton, Oregon. By working with that company and working with the member semiconductor companies, we provided a critical piece of equipment manufacture which we think is three times faster than anything available in the market today.

I could give you a similar example for semiconductor tracks, an important part of manufacturing particularly in conjunction with

lithography where we've been able to get a common set of standards developed by all of our member companies by a single supplier that has given them a unique piece of equipment that we think represents market leadership. It's these kind of successes that allowed Motorola to purchase 80 percent of the equipment in their new $650 million lab in Austin from American suppliers where two years ago when they started planning for that facility they were planning on purchasing 80 percent of that equipment from foreign suppliers. That's a very positive sign, I think, for the equipment manufacturers in the United States and for the American semiconductor manufacturers. And although we will have reached technological parity, I think, with the market competitors we have by 1993, our competition has certainly not been standing still and we are going to need continued efforts to retain that parity and ultimately to regain the market leadership that we had in the early 1970s.

We see not only important gains to be made in manufacturing technologies but we think there are other changes in policy that are necessary as well. I certainly would support Dr. Rodgers' point that anything we can do to take away the short term focus of our market, I would be supportive of and I think most of our member companies would as well. We also need access to markets everywhere in the world. The United States is no longer the largest user of semiconductor devices therefore we have got to have access to European, and more importantly, to Japanese markets. We've got to lower tariffs where they exist and particularly in Europe. We've got to make major improvements in our educational system, we've got to be able to provide patient, low cost capital, I believe—absolutely believe— we've got to make the R&D tax credit permanent and I believe we've got to reduce the depreciation on capital equipment from its current five years to some smaller number. I think we also need cooperation. There is a growing recognition in industry and in Government that individual American companies are going to have a very difficult time competing with entire regions in the world. In the United States we have just begun to think about it. I think it's important to think about Sematech as an experiment but I think it's unique and I believe it's a model which we can use for the future. Finally, I think we've got to be patient with these things. If you look back at the point that Dr. Nishi made, the Japanese started the effort in automobiles and semiconductors and electronics several decades ago. It didn't come about, their preeminent position in consumer electronics, over night. I think we are faced with two choices, we can declare this the end of U.S. electronics leadership or we can look at it as a dawning of a new day and a day in which—of commitment to return the American semiconductor industry to its leadership role. We at Sematech believe this is the dawning of a new era for the U.S. semiconductor industry and we're proud to be a part of it.

Thank you for the opportunity of talking and I'll be glad to answer any questions.

[The prepared statement of Dr. Spencer follows.]

TESTIMONY BEFORE THE

U.S. HOUSE OF REPRESENTATIVES

HOUSE SCIENCE, SPACE AND TECHNOLOGY COMMITTEE

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS

SEMICONDUCTORS: THE ROLE OF CONSORTIA

WILLIAM J. SPENCER

PRESIDENT AND CHIEF EXECUTIVE OFFICER

SEMATECH, INC.

July 23, 1991

Washington, D.C.

Good morning, Mr. Chairman. Thank you for inviting me to testify before your subcommittee. I am honored to appear before such a distinguished panel whose members have provided excellent leadership on the many difficult yet important technology issues facing this nation.

I have a prepared statement that I would like to submit for the record with your permission. I would be happy to summarize it for you.

About eight months ago, consortia became a big part of my life when I succeeded my friend, the late Dr. Robert Noyce, as the president and chief executive officer of SEMATECH.

I believe that SEMATECH is one of the most innovative R&D efforts I have ever been involved in. I am pleased to report that SEMATECH is achieving its first fundamental change by proving that fierce American competitors in the same industry can work for the common good in an environment of precompetitive cooperation.

By focusing on its national research and development mission, SEMATECH brings the combined expertise of industry, government, and academia to bear on a national problem.

Before I discuss what we have learned from the SEMATECH experience and what the government's role in consortia should be, I would like to examine how the United States lost its leadership in a key strategic market - semiconductors - and how that loss of market effects our economy.

At the end of World War II, Japan and the United States both set out on strategic missions. Japan's goal was to build a strong, resilient economy. The United States was determined to win the Cold War. Both have succeeded.

Where do we go from here? Japan's course is set. They have taken a seat beside the United States as an economic world power.

Our course is less certain. Clearly we wish to remain a world power, but I believe that will require a major shift in our national priorities. It is time the United States realizes that national security no longer means simply having a strong defense.

National security today and in the future means having a strong economy as well as a strong military force. We need to understand that the technology base for our military capability depends on being a leader in commercial technology.

The United States is unequaled in technological invention. The list of products invented here but commercialized by foreign vendors is staggering. From television sets to automobiles to VCRs and camcorders, foreign competitors have taken our technology and captured the market.

They have done it in semiconductors as well. You all have seen the statistics and heard the story. Between 1975 and 1990, the U.S. market share in this key industry fell from roughly 70 percent to less than 40 percent. The same was true in the semiconductor materials and equipment industry. In 1979, the U.S. SM&E industry's share of the world market was 76 percent. By 1990, the U.S. market share had dropped to 43 percent.

Why should we be concerned about those figures? Semiconductors are the driving economic force for the electronics business, which today represents more than $750 billion in global sales.

Semiconductors are a uniquely American invention. In fact, Bob Noyce and Jack Kilby of Texas Instruments, are credited with inventing the integrated circuit. Furthermore, U.S. corporations developed the entire market for semiconductors and for semiconductor processing equipment.

Semiconductors are essential for our military security. That was effectively demonstrated by the smart weapons in Operation Desert Storm, the most impressive display of U.S. technology since Neil Armstrong walked on the moon.

I firmly believe that semiconductors are equally important to our national economic security. We are in the Information Age and the computer chip is the key raw ingredient for virtually every technology that is being developed today.

In short, a healthy, thriving semiconductor industry is essential to a healthy, thriving United States.

The semiconductor market was not the first one the United States lost. Earlier, we lost the television market. The story of how we lost that market has been well documented.

But let me illustrate our market loss with an example from the photolithography business. Photolithography is a key step in manufacturing integrated circuits.

In the mid- to late 1970s, most lithography was done by a process called projection aligners that was invented by Perkin-Elmer company in Danbury, Connecticut. Although the market was very small in the late 1970s - only $100 million - Perkin-Elmer dominated it.

By the early 1980s, the GCA corporation had invented a new technology which provided improved resolution for making high-density integrated circuits called step-and-repeat or, as the equipment later became known, steppers.

Steppers cost a great deal more money, but the improved resolution gave much denser circuits and proved to be a better way economically to manufacture semiconductors.

Both technologies were American-invented and U.S. companies dominated the early market. However, two Japanese companies that had been in the photography business, Canon and Nikon, recognized the importance of photolithography equipment. Semiconductors already were a national policy for Japan and Canon and Nikon entered the photolithography market.

The Japanese companies designed and manufactured both projection aligners and steppers that were of higher quality than the U.S. equipment. As a result, the U.S. market share dropped from more than 90 percent to less than 10 percent. The market itself grew from $100 million in 1978 to more than $1.2 billion in 1991.

During this time, there has been only a single European supplier who has never had more than 10 percent of the entire photolithography market.

Why did this loss occur? Semiconductors were a national priority for Japan. Photolithography equipment is a key element in the manufacturing of semiconductors.

Many have argued that Japanese home markets were protected, low cost government loans were made to key Japanese industries, and the Japanese dumped products in the United States.

I agree with most of those arguments. However, one point stands out to me and that is the Japanese designed and manufactured better equipment than we did in the United States. Without having quality equipment, protection of the home market or dumping would not have been as successful.

How did the Japanese develop this superior equipment? The techniques they used in the semiconductor industry are similar to those they used in the automobile industry.

They focused attention on manufacturing; on manufacturing technology, process and tools. They worked closely with their suppliers and invested the effort and resources to assure that these suppliers succeeded. They emphasized quality in ways that increased reliability and improved quality. Their success in manufacturing was not a function of technological breakthrough but more of concentrated effort, the kind that emerges from extensive collaboration.

Of course, there were other factors as well. The Japanese government chose semiconductors as a national priority. Industry and government cooperated in high-risk, high-return ventures. Capital resources were ample and persistent.

The result was equipment that proved to be more reliable, had higher throughput, and provided a lower total cost of ownership.

The Origin of SEMATECH

It was in this environment in 1987 that SEMATECH was born. The Defense Science Board realized that without a semiconductor manufacturing base in the United States, future weapons systems would depend on our ability to secure semiconductors from foreign suppliers, a situation best avoided especially in wartime.

Shintaro Ishihara, in his new book, "The Japan That Can Really Say No," writes that it was Japanese technology and computer chips that made our smart weapons so successful in Operation Desert Storm. He claims that Japan made 92 of the 93 foreign-made semiconductors in the weapons used by the United States in that brief, but highly successful, war.

You may recall that in his earlier book, Ishihara suggested that Japan could change the balance of world power if it chose to sell its chips to the Soviet Union instead of to the United States.

The Defense Science Board recognized the implications of a weak domestic semiconductor industry in this country. SEMATECH was created by industry and government to focus on semiconductor manufacturing technology. SEMATECH is not a Japanese solution or a European solution. It is an American solution.

While I believe that SEMATECH will achieve its technological goals by the end of 1992, our bold experiment has not and will not attempt to solve all the economic, trade, policy, or political issues that the United States faces.

SEMATECH does represent an effort to bring together the best of U.S. industries supported by matching government funds to determine whether this country can regain leadership in manufacturing technology in a critical industry.

By all comparisons to Japan and Europe, this is a modest experiment but it has tremendous implications for the semiconductor industry and for the nation.

As you know, SEMATECH became a reality on Aug. 7, 1987. Fourteen U.S. semiconductor manufacturers and the Department of Defense through the Defense Advanced Research Projects Agency (DARPA) joined together in this unique partnership of government, industry and academia.

We moved into our facility in Austin, Texas in August 1988 after a Class 1 clean room was constructed in a record 32 weeks. We produced our first wafers in March 1989.

Our mission is simple: To provide the U.S. semiconductor industry the domestic capability for world leadership in manufacturing.

SEMATECH brings together government, industry and academia to provide a forum for communication and coordination of effort. We work closely with 27 universities in 11 states with our SEMATECH Centers of Excellence program. The supplier community is involved through our Joint Development and Equipment Improvement programs.

We utilize the expertise at our national laboratories to involve experts in as many fields as possible to develop tools and processes for our member companies and the entire U.S. semiconductor industry.

SEMATECH operates a fabrication facility in Austin not to produce chips for sale in the marketplace, but to test equipment, processes and materials so that companies can immediately rely upon and implement the technologies that have been developed.

What We Have Learned

While critics claim American competitors cannot work together, SEMATECH proves them wrong. While competitors say American industry and government cannot team effectively, SEMATECH proves that technical innovation and rapid learning can be increased by such a focused, coordinated partnership.

People from 14 companies can work together if the issues are properly defined. At SEMATECH, these issues are: precompetitive tools and associated unit processes, materials, manufacturing systems and methods. This is opposed to competitive areas such as specific commercial products and processes.

SEMATECH is vital to U.S. semiconductor manufacturers because it provides insight into future needs and allows industry to agree on "gap plugging" efforts to provide the required technology.

Leveraging of resources and expertise is possible and necessary for each SEMATECH participant: the semiconductor industry, the equipment industry, academia, and the government. For example, SEMATECH and DARPA enjoy mutual benefits from sharing information and resources.

SEMATECH does not have a role in assembling complete commercial product fabrication processes - but does have a critical role in developing and qualifying unit processes, manufacturing methods, standards, systems and equipment.

SEMATECH serves as a point of national focus for semiconductor manufacturing technology and must have a proactive agenda. It has a role in strengthening the fragmented U.S. industry structure. It can work with universities and national labs as partners in improving manufacturing competence.

I believe that the consortia approach offers several advantages.

First, industry drives the mission and shares the cost with the government. The management of the consortia is done by industry with guidance and cooperation from the government. I believe that government benefits from the expertise of industry in ways not likely if it were a traditional government-contractor relationship.

Second, as the center for manufacturing technology research, we can focus our resources for maximum impact. Even if SEMATECH is only partially effective, the return to our member companies and to the government should be much greater than their investment.

The focusing of resources on key industrial problems can provide sources of competitive advantage for each company. In SEMATECH's case, this generally means the development of key manufacturing tools or methods that give individual corporations the opportunity to build semiconductor applications for their particular businesses.

Perhaps the best example of this is in the area of single qualification of a new manufacturing tool for all 14 member companies. This is a major savings for the member companies and provides a single interface for the equipment manufacturer.

Third, by pioneering research and development and sharing our knowledge with our members, we maximize member investment. We have the luxury of taking on high-risk, high-return projects that no one company could afford on its own.

An individual company may not be able to afford to invest tens of millions of dollars in a new piece of equipment or a new manufacturing method only to have it fail. This is particularly true in the development of computer-controlled manufacturing, major software programs, and the development of key pieces of equipment such as X-ray lithography and even next-generation light lens lithographic equipment. If a project fails, we fail once, not 14 fourteen times.

Fourth, SEMATECH is providing an important forum for the open exchange of information. For example, we recently held a manufacturing management symposium which drew engineers from around the United States.

Universities and professional societies do not provide a meeting environment for exchange of information in manufacturing. Bringing manufacturing people together in consortia programs and meetings has proven to be an effective method of exchanging ideas.

Fifth, the development of quality programs that provide the same sort of processes and standards for multiple companies and their suppliers is a major advantage. Almost every corporation in America today has a quality program of some sort. By standardizing courses, nomenclature, and processes, it is possible to derive even greater gains in these quality programs.

At SEMATECH, we have launched an industry-wide Partnering for Total Quality program that I believe will have a lasting effect on the way suppliers and manufactures in this country deal with each other. That impact will be equally as great - if not greater - than the technical impact we will have.

Government's Role in Consortia

One of the important questions being asked in government and industry today is whether or not public money should be spent on U.S. consortia. I firmly believe that is a good investment for the government for several reasons.

Government investment in consortia is a good leverage of federal R&D dollars. For every dollar the government spends on SEMATECH, private industry matches it dollar-for-dollar. In turn, the dollars that SEMATECH spends on Equipment Improvement Programs and Joint Development Projects are matched by participating companies on at least a 1:1 basis and sometimes by 2:1 or even 3:1. At a minimum, that is a 3:1 leverage for those government funds. I don't know of any other federal programs that have that kind of impact.

I believe that federal spending on consortia is a good investment for the government on broad economic grounds. In the case of semiconductors, each percentage point of market share that is retained or regained by the United States represents 3,000 jobs in this country.

In the 1980s, the U.S. semiconductor industry lost nearly two percentage points of world market share per year in this rapidly growing business. The electronics industry in this country employs more people than the automotive, steel and aerospace industries combined.

If federal funds can be used to turn that market share loss around, the return in jobs and taxes will far outweigh the actual dollars spent in the consortia. The choice of high growth areas with good profits makes the return on investment for federal dollars even greater.

In the field of electronics, including semiconductors, the world market is still growing at a double digit rate and is expected to continue well into the 21st Century. That makes semiconductors and electronics a particularly attractive area for future government investments.

Government investment has always been appropriate for generic research whether it is in agriculture, aerospace, basic sciences, or semiconductors. Furthermore, the private sector, if left on its own, will under invest in R&D.

I believe that the government should invest in consortia because we are competing with global regions that are using cooperative investments between private and public funds.

This is nowhere more apparent than in Europe where vast amounts of effort and resources have been devoted to collaborative ventures. Although the impact of these programs such as JESSI, Esprit, and the other government-industry partnerships is still preliminary, it appears as though the joint ventures are continuing undiminished and the probability is high that these collaborations will pay dividends in the future. One only needs to look at the success of Airbus to see the impact European subsidies
can have on a targeted industry and how it can affect U.S. industry.

Within Japan, the cooperation between government and industry has already made major gains for that nation in the field of integrated circuits, consumer electronics, automobiles, shipbuilding, and steel, and is beginning to pay off for the nation in telecommunications, computers, and pharmaceuticals.

SEMATECH's Impact

When we develop the leading-edge technologies we have planned, our members indeed will have the ability to regain world market leadership. The adoption of straight quality programs throughout the industry will assure the United States a continued major role in the semiconductor manufacturing industry for years to come.

To date, SEMATECH has had success in developing and improving both processes and equipment which already are being employed in the industry. We have demonstrated .5 micron manufacturing on all American made equipment, a first for the industry.

We have helped U.S. companies purchase U.S. equipment and slowed the market share loss in the semiconductor equipment and materials business. Let me share a couple examples with you.

SEMATECH was instrumental in helping a small company, ATEQ, in Beaverton, Oregon, develop a laser mask writer - a critical piece of equipment in the production of semiconductors - that is three times faster than anything else in the world.

Another unique SEMATECH program involved SVG, Inc., a California company. SVG had developed a silicon wafer handling system known as "tracks," which moves wafers through difference manufacturing sequences. Three U.S. semiconductor manufacturers were driving SVG to develop individualized custom processes. In fact, a standard set of processes would have best served them all.

SEMATECH pulled the three manufacturers together, sat them down with SVG and got them all to agree on one common goal. SEMATECH then created a project team involving engineers from five different companies and they went to work to solve the problem. As a result, the SVG tracks is a world class tool that is being shipped to SEMATECH members as well as to other semiconductor manufacturers. SEMATECH created the environment that not only allowed that to happen, but made it happen. SVG has an order for every tracks system they are capable of producing in 1991.

The unique advantage of SEMATECH is that 14 companies cooperate in an environment in which they all bring their expertise and experience to bear. The companies can work together to define and solve common problems, thus benefitting the entire industry. The manufacturers can join together and solve problems that would be too expensive or too difficult for one company to tackle alone.

Furthermore, SEMATECH is a unique test facility where equipment manufacturers can test and qualify their tools and processes. That is a one-time proposition and everyone can share in the results.

These are the kinds of successes that made it possible for Motorola to radically change the equipment purchases for its most advanced semiconductor plant. When Motorola dedicated its new MOS 11 fab in Austin in April, company officials credited SEMATECH with enabling them to put more than 80 percent U.S. equipment in the $650 million facility, a complete reversal from their original plans to use 80 percent foreign equipment.

That is a very positive sign for the U.S. equipment and materials industry, which is striving to become more competitive in world markets.

Sam Harrell, president of SEMI/SEMATECH, reports that in 1990, the Japanese had 51 percent of the world market share for fab equipment. During that same year, U.S. equipment manufacturers had 36.6 percent of the world market share; 70 percent of the U.S. market share; 48 percent of the Asia Pacific market share; 44 percent of the European market share; and just 14.5 percent of the Japanese market share.

SEMATECH has helped Hewlett-Packard and the National Security Agency construct their new fabrication facilities in Corvallis, Oregon and at Ft. Meade, Maryland, respectively, more quickly.

Further successes will come, and by 1993 we expect to have a U.S. equipment supplier for each key process in semiconductor manufacturing: lithography, furnaces and implant, planarization, and deposition.

SEMATECH will have developed the capability for the manufacture of 200-millimeter wafers with .35 micron geometries.

Policy Recommendations

Although we will have reached technological parity by 1993, our competition has not been standing still. Technological parity alone is not enough to ensure increased market share. We still need other changes in policy to enable that.

Most importantly, we need open access to the largest semiconductor market in the world - Japan. Despite agreeing in 1972 to open their domestic electronics market to foreign competitors, Japan has never allowed U.S. companies to have more than the current 13 percent share of the market. Most years, the average is about 10 percent.

The New Semiconductor Agreement recently negotiated and signed by the U.S. and Japanese governments will help. Without access to that Japanese market, however, U.S. companies always will be hard pressed to prosper.

We also need to reduce tariffs in Europe; improve our educational system; provide patient, low-cost capital; make the R&D tax credit permanent; reduce the depreciation on equipment from five years to three years.

To use a sports analogy, it is game, set, and match point and our opponents are serving. We will have leadership technology again. But we need a number of other capabilities to compete globally.

What we now have to do is be tough-minded and urge our government to make the tough choices necessary to give us a fighting chance to compete.

We should demand:

* Sound fiscal management to reduce the federal budget deficit. That would reduce the cost of capital and improve the climate for investment which can further improve our productivity.

* High quality education, again leading to improved productivity through a well-trained work force.

* Increases in the patience of capital through indexing the capital gains rate to encourage long holding periods for investments.

* Crisp management of our universities and national laboratories to utilize this unique resource that is unmatched anywhere else in the world today.

We also need to have cooperation. To quote the Computer Systems Policy Project, "The cooperative R&D investments by the private sector and governments worldwide demand a new level of cooperation between industry and government in the United States."

There is a growing recognition in industry and in government that individual American companies can no longer compete with entire regions of the world.

Japan's industry and government have been cooperating for years and they do it very, very well. In Europe, government-industry cooperation has been going on for years and is growing. They haven't gotten it right yet, but they keep trying and I believe ultimately they will succeed.

We have just begun to think about it. SEMATECH is unique in this country, but it is a model for the future. I believe that consortia will play a key role in future R&D efforts around the world.

Finally, we must be patient. We won't solve some of our problems this year or even this decade. But that doesn't mean there is any less urgency in getting started.

When Toyota first exported automobiles to the United States in the late 1950s, the cars were not popular by any stretch of the imagination. But by working hard to understand the customers and by pioneering lean manufacturing, Toyota became a leader in the automotive industry in only 30 years.

We need that kind of vision in America today. We are starting to wake up to the fact that blind, self-indulgent gusto is not vision at all, but denial. True vision requires the forging of a farsighted and realistic connection between our present and our future.

We have to begin by setting national priorities. Leadership in the semiconductor industry must be one of our nation's highest priorities. It means recognizing in today's choices the sacrifices all of us must make for posterity.

We can either make those hard choices or convince ourselves that second or third best is good enough. I don't believe America will settle for anything less than being the best, and I don't thing we should settle for anything less than number one.

We can declare this the end of U.S. electronics leadership or the dawning of a new day, one of commitment to return the American semiconductor industry to its leadership role. We at SEMATECH believe this is the dawning of a new era for the U.S. semiconductor industry and we are proud to be a part of it.

All of us firmly believe that by working together we can regain leadership in this key industry and provide the base for the United States to remain a major global economic player.

Thank you for the opportunity to testify before you today and I would be happy to respond to any questions you might have.

Mr. BROWN. Dr. Spencer, your testimony is extremely important and we'll want to raise a few questions with you about it but first let me recognize Mr. Rohrabacher who has to leave shortly for a brief period.

Mr. ROHRABACHER. Mr. Chairman, I'd like to thank you and I first of all would like to congratulate the Chairman for the leadership that he is showing as exemplified by the fact that we are having this hearing and we are focusing on this issue and Mr. Chairman, thank you very much for the leadership you are providing in this.

Mr. BROWN. I gratefully accept that recognition even though Mr. Valentine did most of the work.

Mr. ROHRABACHER. I have to leave and I'm sorry. I appreciate your testimony and I'm going to look over the—I have to leave for the question and answer period but I will be reading the transcript and just thank you all very much. I've learned a lot at this hearing today.

Thank you very much, I'm sorry I have to leave. You know when you are in Congress, you have about 10 different things to do at any one single moment but I've learned a lot today and your testimony has been very enlightening and I will be using it in the future.

Thank you, Mr. Chairman.

Mr. BROWN. Thank you, Mr. Rohrabacher.

We will now start questioning with Mr. Lewis first and then we'll rotate back and forth.

Mr. LEWIS. Thank you, Mr. Chairman. I have to say we're very fortunate to have such a specialized set of witnesses to—and it's interesting that we do have some disagreement with our witnesses which I am going to probe a little bit. I also thank you, Mr. Chairman, for having this hearing as well as Chairman Valentine, it's a shame that we have to have a hearing to determine what it will take for us to become more competitive with our foreign competitors. They don't have meetings, they just go out and beat the pants off it, so it certainly is disheartening at times.

I'd like to ask you, Mr. Spencer and you Mr. Rodgers to start off if I could—Dr. Rodgers, both of you.

What is the status of the U.S. semiconductor production and research today compared to 1987 when Sematech started?

Dr. Spencer?

Dr. SPENCER. Let me start and then I'll let Dr. Rodgers answer.

I think the situation in the United States, as far as our technology level, has not made significant changes in that time frame. If you look at the market changes, as Dr. Rodgers pointed out, in 1990 there was an up-tick in U.S. market percentages. That was a positive indicator for all of us. I am concerned that a large part of that was due to the change in cost of D-RAMs coming from Korea and Japan.

I think we are beginning to provide a change in the infrastructure in the United States that I think can ultimately have a major impact on the technology capability. And if we look at technology here and we limit it a moment to the technology that's needed to produce the highest performance integrated circuits, usually that's—the memory area leads that and followed very closely by

microprocessors and logic—I think we are in a position to begin to make a change in the American position in that, but I haven't seen a significant change in the last three or four years.

Mr. BROWN. Dr. Rodgers?

Dr. RODGERS. The particular year you asked about, 1987, is in the middle of the period from 1985 to 1991 where I believe we've held parity with the Japanese. And specifically answering your question, I believe the best of American technology is on a par with the best of technology—was in 1987 and is now. My company happens to specialize in very high performance integrated circuits and we pride ourselves on selling the fastest that you can buy anywhere and we don't feel that we've been in an environment—we also buy American equipment, it's a policy I have to sign if we don't buy American—and I don't sign. We think we can do it in the United States and that we're at parity. That's changed from the period of 1985 through 1979 when we were losing it very badly. We in the semiconductor industry, we managers, have to take the rap for that poor performance, it was due to lousy quality management, the same thing that you might have complained about in your car with the door not fitting right, on a microscale we were doing the same thing. Our fault, didn't have to do with consortia, didn't have to do with capital gains, it had to do with bad management. That's getting fixed and that's one of the reasons that we've started to turn back around. We've realized we've got a problem of our own and we better fix it ourselves now because the process here to get it fixed—we'll all be gone.

Mr. LEWIS. In Dr. Spencer's testimony he pointed out that Ishihara, in his new book *The Japan That Can Really Say No*, he claims that Japan made 92 to 93 foreign-made semiconductors on weapons used by the United States, and then a following comment that you point out that Ishihara even suggested that Japan consult the Soviet Union rather than the United States. This is certainly a frightening situation, to a degree, but at the same time also again shows the smart applications of the Japanese industry in management rather than sell to the Soviet Union. So as a scare tactic that's one thing but also looking beyond it shows good business practices in the long run in the way that you chose your friends.

I'd like to ask all of you before I run out of time, is a Government/industry consortium the best way to improve U.S. research in semiconductors and would better progress have been achieved if the tax dollars that were invested in Sematech had been invested differently, and if so how would you describe the investment of dollars?

Do you want to start, Dr. Sumney?

Dr. SUMNEY. My feeling is that the cooperative activity with the Government, the universities, and industry is a cost effective way to spend tax dollars. Sematech is an example of one model of how that is done, other models exist. My feeling is that the problems are reasonably clear, that the Government is a major customer. Certainly the Defense Science Board Task Force on Semiconductor Dependency, as Dr. Spencer alluded to, addressed this whole issue back in 1987. Ishihara's claim that has been made recently, refocuses on that issue. The Government is a major customer of inte-

grated circuits and they do have needs and concerns that need to be addressed, so I think it is a very useful way to spend money.

Mr. LEWIS. Dr. Rodgers?

Dr. RODGERS. First a comment on Mr. Ishihara. He's way off base, he doesn't know what he's talking about. It maybe true that Japan sold 92 types of semiconductors into the military market it just so happens that my company which is a $300 million company not big by standards sells 800 different military parts, 480 of which were in the Gulf War. There is nothing that flew F-18, no smart bomb, no picture you saw that didn't have one of our chips in it and we're only the eighth largest military contractor in the U.S.

If you want to criticize us it's because we did so well in that war. We spent a lot of our semiconductor expertise making those weapons which work very well. We own them, we did a good job, it was not a Japanese victory, it was an American victory. Meanwhile, we don't own the television industry or the hi-fi industry and that's perhaps what we left behind in order to have these military products, but at least we should give credit to those military contractors that did a good job.

With regard to your second question on where should Sematech money be spent, I still maintain that it is unfair to focus Government money on 14 companies when there are literally hundreds of other companies that are being left out. I think that money would be much more effectively spent divided up into $20 million dollar chunks, MIT, Cal Tech, Stanford, Berkeley—one more school—every year and dedicated toward integrated circuits—SRC also. And let's start educating people and getting them out, to me there is much more leverage in education than in a given consortium for the benefit of a few companies.

Dr. SPENCER. Let me agree with the point about the Persian Gulf War. I think Ishihara is incorrect in that we couldn't have won that war without Japanese parts. I believe there is capability within the United States to build all of the parts necessary to have weapons be 100 percent U.S., if we chose to do that.

The problem that I am concerned about is, that won't be true five years or ten years from now. I'm concerned that we will continue to lose market share, we'll end up with companies who are not competitive in global markets and the fact that technology today is not being driven by the latest weapons system but it is being driven by the next generation of Sony Walkman or Brother Computers or something else. It is a major, major issue for us so I think it's a concern of where we are going to go in the future. I think we're living, to some extent, off of our seed corn.

I certainly do not want to speak out against funding of U.S. universities. I believe our research universities are a national asset and we need to protect those. However, universities by their very nature, are very open organizations and we have probably better utilization of research results today from Europe and Japan than we are getting out of the American industry. Now, again, that's American industry's problem. We do not use universities results as well as we should, and partly it's because of the point that was brought up earlier, we've got a very short term focus on what we are trying to do. We've got to meet profit goals on a quarter to quarter basis or bad things happen to us in the stock market.

I think that—the reason I emphasized in my remarks the experimental aspects of Sematech is exactly that. I believe we're in such a complex area of intertwined economics, policy, politics, management, technology that we don't know the theory behind it. We can't predict what's going to happen. We're going to have to run experiments, and if there is a better experiment, if there's a way to designing a better experiment than Sematech, I'd like to hear about it. I think we have the flexibility of making changes in it to make it perform better, and we're constantly—we believe in a learning situation where we're trying to understand what it is we've done right, what it is we've done wrong, and how do we build on the strengths that the Nation has to bring us back into a leadership in an industry which, I think, is absolutely essential to the future of our Nation.

Mr. Lewis. Thank you.

Dr. Rogers. I think that American competitiveness is more than just a discrete role of manufacturing. I think it's the issue of getting new products to the marketplace quickly and meeting the quality and cost structure that's required to be competitive in a world market. I think that Sematech is focused in on a very discrete element of the total process. I don't think that it's a bad investment, I would question, though, being a discrete investment, if that investment wouldn't better be put to use in the universities, as Dr. Rodgers has pointed out. They deal in discrete problems that work on elements of the total process as opposed to trying to put the total capital structure together to have an integrated solution for time to market.

And that's the real issue, it's how do you come up with a product idea, get it to the marketplace with the kind of quality, the kind of production that you need to compete in the world market. So from my perspective, I think that Government funding more in the universities like MIT, Stanford, and Cal Tech would probably provide the kind of results that companies like Cyrix would have access to and could use in continuing to drive the competitiveness from our sector.

Mr. Lewis. Dr. Nishi, you almost answered this question with your last comment about preparing the infrastructure of the soil for the seeds of your harvest.

Dr. Nishi. Yes, and I'd like to mention a few things— that is this is my observation and also my understanding that if you look at the VLSI technology itself, the U.S. is clearly ahead of Japan. The only exception in VLSI business in the global sense is the manufacturing capability and also aggressiveness in manufacturing capital investment. Therefore, when I am asked by somebody coming from Japan, what is my view about the technology comparison, my answer is very clear that slowly but U.S. we are ahead of you.

However, it will not be continued forever if we cannot regain our aggressive manufacturing capital investment attitude as strong, and at the same time the long term investment attitude because R&D expense to stay at the leading edge is growing very sharply, therefore the only way to fund those kind of investment in R&D is to have much larger manufacturing base or revenue base. Therefore, that is one point.

The other thing is, if I compare U.S. and Japan in university area we are clearly ahead of Japan in generic technology research, therefore I strongly support more heavier funding for university research at the same time I really like to see more interactive relationship with universities because we—industry is responsible to provide what should be coming or what will be coming in year 2000 from industry point of view which may not be clear enough for university people. And also we in industry should learn from the university what could be the opportunity of prosperity in the newly emerging technology area. Therefore, I think we have to invent some new mechanism to positively and also most productively get a gain from university research for the success of our industry here.

Mr. LEWIS. Thank you, Mr. Chairman. Thank you, gentlemen.

Mr. BROWN. Ms. Horn?

Ms. HORN. Thank you, Mr. Chairman.

Gentlemen, it's been very, very instructive and I very much appreciate the—Chairman Valentine or whosever idea it was to have these varying points of view. I know I've learned a lot this morning myself.

Dr. Rodgers, you had some very provocative thoughts to offer to Sematech and perhaps I'll help you by asking a couple of your questions of them. For instance, you talked about the dues structure which totally—which in your view discriminates against the smaller companies, I'd like to ask Dr. Spencer where did that dues structure come from and surely when it was put together it was realized the effect it might have or do you have some other comments to make on that topic?

Dr. SPENCER. I can't answer the details of where the dues structure came from. It was negotiation between the member companies who set up Sematech and the dues structure, by the way, is a floor of $1 million or one percent of semiconductor sales, so any company that is making $100 million a year in sales or more pays a share that's equitable with everyone else who is in that organization. It is hard to argue that it doesn't discriminate against those companies whose sales are under $100 million.

At the present time the dues structure and the membership in Sematech is a part of the discussion of what the board of directors wants to do for Sematech in the future. And although it's strictly a discussion point, at this point we have not made any decision. We're looking at opportunities for further partnering with groups in the United States the way we have with the semiconductor manufacturing equipment. Those companies pay no dues to Sematech and of course are major recipients of the investments that we make.

And I think we should be looking at the defense industry and other aspects of the industry for partnering the way we have between equipment manufacturers and semiconductor manufacturers. I believe that's one of the things that Japan has done extremely successfully. My experience in being there over the past 30 years is they have partnered together better than we have. I think there is an opportunity for us to— one of our biggest successes, I think, is the interaction in what Mr. Brown would call a vertical consortia where we are looking at equipment manufacturers to semiconductor manufacturers and the next obvious bridge is what do you do

about the users of those? Are there ways that we could work together with them as well?

Ms. HORN. The board of directors who are looking at the restructuring, if there is such, of Sematech II are the 14 companies that now belong to it and are the larger companies, is that accurate?

Dr. SPENCER. Our companies range in annual sales from around $3 million or $400 million to $60 billion so they're a fairly broad range of companies and it is a—each company has a single vote, but I think there is a recognition by the entire group that we need to relook at the membership in Sematech and see if there are changes that should be made to it.

Ms. HORN. And is some of that discussion around the idea of getting some of the smaller entrepreneurial, new start-up companies involved at some level?

Dr. SPENCER. Well, the discussion is around how we might change the membership in any way that would make Sematech more successful. Certainly that group is one we would consider along with all of the other groups that might be represented in Sematech.

Ms. HORN. Well, I guess I'm thinking of it in terms of the taxpayer dollars involved and that seems to have—be some conflict between that and the successful venture in terms of the larger goals of the company—the corporation.

Also, in the hold-back provision that is part of the charter that that is done when the companies buy-in, they agree to that hold-back provision, that's something that is required?

Dr. SPENCER. I think that's an interesting point, again when Sematech was first set up and you start a consortia between private and public funding organizations for the first time, you are breaking a lot of new ground. And certainly the initial intent was to be able to provide semiconductor equipment to member companies earlier than to competition.

What the reality of what has occurred is that we recognize the equipment manufacturing industry has got to come back into a leadership position in global markets the same as semiconductor manufacturers do, and they absolutely cannot d that if they are not allowed to sell equipment everywhere in the world.

So in our equipment improvement programs and our joint development programs, we believe the gains to the Sematech members come about in the development stage of that equipment where the equipment may be on site in one of the member companies but with engineers from other companies in that site as well learning about that equipment early on. They have an opportunity to make changes in it as soon as that equipment becomes commercially available. We think if the equipment manufacturer is going to succeed and not have to be continually limited in the market they can get into, we have got to allow them to sell everywhere. So that's a policy that is undergoing change.

Now, as a result of that we are liable to lose some members of Sematech who feel very strongly about that and we'd be delighted to have somebody who feels differently come in and fill one of those positions if they'd like to.

Ms. HORN. Well, I think with that I'll have to give Dr. Rodgers the opportunity to comment on the previous response or to—or

how he—how you see that. Do you see that as a way the consortium might justify itself by being more open and perhaps changing some of the practices now in a revised charter?

Dr. RODGERS. The answers I just heard in very short form were yes, the current structure does discriminate against small companies and we're thinking about changing that, and yes, we have held back equipment from the market and we're thinking about changing that.

Here is the way that I ran into that. I sent engineers to Phoenix, Arizona to evaluate a modern piece of semiconductor equipment from a company called Westech in Phoenix, Arizona. My engineers told me that they thought they weren't getting access to the most modern equipment which outraged me. Called the—ordinarily you go and buy something, you are the customer—these things are half a million dollars each—you get treated very well—called the president, didn't get an answer that satisfied me, forgot about it.

This January 8th, I got called up by the tax assessor from Travis County, Texas. Seems he had a problem. Sematech had declared themselves to be a charity and he didn't think they were a charity. He thought they should be paying school taxes and Sematech had hired Jaworski's law firm out of Houston to sue Travis County, Texas and there was a large law suit and he asked me if I'd come down and testify on whether or not I thought Sematech was a charity, which I was glad to do because it is a charity and I can name the 14 recipients of the charity.

So I finally got my Westech contract via the discovery process, and there it was in English, you will withhold equipment for a period of one year from the time you would otherwise introduce a product to the market. That's the thing that's got me so irate, that's the thing they've got to change, and a short answer to your question, yes, if they stop some of those practices the noise level would die down.

And I think with a $500 million kick-start Sematech and these huge companies, by the way only two of Sematech's 14 members are under a billion dollars, they are big—that with a half million dollar kick-start from the Government, they ought to be able to go their own way in the future, and if Sematech is so good and so valuable the payment for it ought to be easy to make.

Ms. HORN. Thank you.

I've found that very instructive and I'd just like, Dr Rodgers, for you to speak a little bit on your alternative, that you make an awfully convincing case for, in your testimony about specializing on the niche markets. How does that fit in with the overall goal of such things as consortium?

Dr. RODGERS. The semiconductor industry is getting ever more complicated and this truly is the bane of the large semiconductor companies. As I said earlier, six of our eight largest semiconductor companies lost money this year but we as a semiconductor industry, with a bunch of new companies—we have some represented here at the table—took ground back from the Japanese, and one of the reasons that is happening is that the semiconductor industry is getting evermore complicated.

It used to be in the Intel Catalogue, when that was the bible of the semiconductor industry, there was a page that was a dynami-

cram; another page that was a staticram; three or four pages that were microprocessors, and all of these semiconductors were in a catalogue that's an inch thick. Today we make 51 different kinds of staticrams, not one. Intel had two, I think, in 1970.

And as the world becomes more and more complicated the specialized people, like my company for example, and staticgrams and programmable logic devices get really good, and as long as we have a high technology way for fabing—and we have three of them, one in Minnesota, one in Texas, one in California—we can compete with anybody. So the world is really evolving toward the small taking over and that's really the trend we are seeing. It's bad news for big American companies and it'll only be a few years before it'll start being bad news for Japanese companies.

So the trend toward niche markets is really a trend toward specialization, is really the final event because engineers now have a computer on their desk which is as powerful as the entire defense industry had at the time we invented the atomic bomb, one per engineer. And these engineers now can create chips at an incredible rate.

We don't need gigantic amounts of capital. In the microprocessor world we thought we were too big, we're only a $300 million company. We started a company with 22 employees and spent only $7 million and we invented an entire microprocessor chip set which is now one of the fastest in the industry and is the Sun Spark Station that you may have heard of, a big, big deal in the work station industry.

So the days when you needed battleships to compete are over. And continuing the military analogy this is the age of the cruise missile, highly specialized and real smart, not very expensive, and very powerful. That's why the big companies are losing to the age of specialization, and the trends to hold up the big companies aren't really in the best interests of the industry at large, the dynamic change I talked about.

Ms. HORN. Well, thank you. I find that very encouraging and very refreshing, and I'll turn it back to the Chairman here, and I am sure there are some follow-ups on that. Thank you.

Dr. SPENCER. Mr. Chairman, could I make a comment on the Westech—

Mr. BROWN. By all means.

Dr. SPENCER.—situation before we leave this.

I think that is an important point, and understanding this might come up, I spoke yesterday with Westech to understand the situation. First, I am pleased that our equipment program there has developed a piece of equipment that's desirable for all semiconductor manufacturers because that was our goal. It turns out they have a fairly large backlog of equipment but I do not believe, and the President yesterday confirmed, that they are withholding that equipment, and all of the changes that we have made, with public and private funds on it, is available to anyone.

Let me give you a couple of other examples. Our largest expenditures here have been in the area of photolithography, and even in niche markets photolithography equipment is very important for us to be able to manufacture. That was an area that belonged to the United States. 1979, 1980, the development of steppers, a key

piece of lithography equipment, was done in the U.S. and we owned the market, 80 or 90 percent of it. At that time it was roughly a $100 million dollar business, today it is a $1.2 billion business. Eighty percent of it is in Japan, the other 20 percent is split about equally between the United States and Europe.

We felt if we were going to be competitive in the semiconductor industry we had to have equipment—lithography equipment—made in the United States, available to us as early as possible. Holding up that equipment by a few months in semiconductor manufacturing could have dramatic impact on your ability to compete in the market, whether it's a new microprocessor, a new memory chip, or a new any-other-kind of chip. Today that equipment is available to anyone in the world to purchase. We felt having a strong U.S. lithography business was more important than having that equipment available only to U.S. manufacturers.

We've recently shipped one of those pieces of equipment, in fact, to Toshiba. In Japan we expect that that equipment will be dismantled, taken apart piece by piece, looked at, and decided what's good in it and can be put in the next piece of equipment that's manufactured in Japan. But we absolutely believe if we don't develop equipment manufacturers here and we're able to design and sell equipment into the global markets, we're going to be in serious trouble. So our focus is on getting our equipment manufacturers back into leadership positions and to do that we'll sell to anyone who will buy the equipment. But when we've got an equipment manufacturer who is manufacturing—who has more orders than he's had manufacturing equipment, he's going to set priorities on it and somebody is going to have to stand in line to get that equipment. You're going to have to be a bit patient to get it. Thank you.

Mr. BROWN. I want to bring this to a close shortly after 12:00, and therefore our time is going to be limited. Let me recognize Mr. Bacchus next and then Mr. Ritter.

Mr. BACCHUS. Thank you, Mr. Chairman.

This is a critical issue involving a critical industry and a very critical technology. As one of you pointed out in your testimony, the electronics industry today employs more people than all of the steels and aerospace industries combined. We want to make certain we keep those employees and get more. In one of my past lives I was a securities lawyer, so I gravitate naturally to the perspective that Dr. Rodgers has offered today in terms of capital costs and long term perspective. I favor making the R&D tax credit permanent. I would like to restructure the capital gains tax, perhaps along the lines that Dr. Rodgers mentioned. I voted earlier this year in the Banking Committee to revise the Glass-Steagall Act. I'm one of those Democrats who supports a constitutional amendment to mandate a balanced budget, in part because I think that would help us as a Nation to establish the kind of future-looking priorities we ought to have.

One thing I noted, Dr. Rodgers, in your testimony, is that you really didn't talk about international trade. In another of my past lives I was also a trade negotiator for this country with USTR and that was in the late 1970s and the semiconductor industry raided through the White House at the time trying to get the attention of people, warning them about changes that were coming. I think one

of the greatest failures of the past several administrations was the failure to heed that warning. So I was struck by the fact that you really didn't mention international trade too much. I'm sure you pay a great deal of attention to it, could you tell us what you think about the new semiconductor agreement with Japan? That is the largest semiconductor market in the world and we do need access to it. Do you think it's going to be helpful to us?

Dr. RODGERS. Thank you very much.

I was under strict instructions to stay under 10 minutes and the thing you asked about was what I decided to pull out, and I appreciate the opportunity to make a comment.

The Semiconductor Trade Agreement No. 2 which was just finished,basically is an agreement between Japan and the United States that Japan will start buying our chips and they'll get the number up to 20 percent. It was negotiated by the SIA—the SIA is sort of the progenitor and prime supporter of Sematech. We're not a member of the SIA, and many people with whom I have philosophical agreements are on the SIA, however I will give them good credit for having done that and it was a good job. And I believe it's right near the edge of how far do you want the Government to get in your business, but I believe in the case of Japan, we need the Government, we need that muscle and that threat to hang over the Japanese.

Now it turns out today because of Semiconductor Negotiation No. 1, which also set a quota and did some other things I thought were very counterproductive, for example, like raising the price of dynamic rams and forcing our computer companies to pay billions of dollars back to the people who supposedly had done something wrong. That was wrong, but the fact that that quota existed in Semiconductor Agreement No. 1 has changed the Japanese. We have customers like Hitachi today in Japan that go out of their way to buy American. They work with us, they are the toughest customer we've ever served, and Toshiba, their laptop computer uses our microprocessor chip set made by that little start-up in Austin.

So I'll give credit to the SIA and the semiconductor agreement for putting a goal out there and in my mind that's the right level of Government intervention: leadership. Set a target, tell us that you want it, tell us that there are going to be teeth behind it if you don't make it, and then let the industry implement and make it happen. So I think that was a pretty good agreement.

Mr. BACCHUS. What about the Europeans. One of the other panelists made reference to problems with Europe. We're looking at next year and their unification, their competition. What do you foresee there?

Dr. RODGERS. I am very pessimistic about Europe. We always focus on the Japanese because they are very good at what they do in our business. If Japan today were telling us what the Europeans are telling us, oh, by the way, we're going to get together. We're going to build a wall and to take your product across the wall it's going to cost you 14 percent, like all your profit, or you're going to fire your American workers which we'd have to do since that's the only kind we have and hire European workers in order not to have your profit confiscated at our border. If it were the Japanese there

would be a visceral reaction across the United States and I'm very surprised that we've had the gun held to our head on this particular issue and not reacted to it. Apparently the Europeans get a better deal than the Japanese when we think about trade.

Mr. BACCHUS. Well, I believe Ambassador Hill's—the current trade representative has recently warned us that we face more difficult trade negotiating issues with the Europeans than with the Japanese. I'm not sure that the Nation heeded her just yet on that.

Dr. Spencer, as I listen to Dr. Rodgers' populistic picture I hear echoes of Andrew Jackson and Woodrow Wilson and Louis Brandeis, notions of countervailing power, he even invokes Shumpeter's notion of creative destructionism. He sees the new wave of the American comeback being led by the small entrepreneurs, he sees the large companies as dying dinosaurs, do you see the industry in this way.

Dr. SPENCER. Well, Dr. Rodgers' view is what a Stanford Ph.D. will give you, I think. Mine happens to come from the midwest in a state next to Ms. Horn.

I think we are entering a time of major change in the market. The opening of Eastern Europe, Russia, and China are examples and I don't know how all of this is going to turn out. One thing I do feel fairly strongly about is that the United States has gotten to the position it has by having a very open society and that generally has meant that if you have an idea and you want to start a company you can generally find enough money to do that. I believe that a lot of those companies, from my experience at AT&T and Xerox before I came into this job, is that a lot of those companies have depended on technology either coming from universities or from large companies in the past, to start those smaller companies. And I don't think we can do away with one or the other, I believe we are going to enter a time when we are going to be competing with large vertically integrated markets.

I agree with Dr. Rodgers on the situation in Europe, I think it holds more risk for us than Japan does. Japan today, Europe tomorrow, and I think the Airbus is an interesting example of Europe's being willing to stick with something for a long time, a huge investment to go after an industry they feel is key. And I know that the economic community in Brussels believes that electronics is essential to the future of Europe, just like we believe it is for the United States. And so we're going to see a lot of competition there and we're going to need the resources of companies like Cypress, and like Intel, and like IBM, if we're going to succeed in those markets. I don't think we can do away with one and not change the American culture in ways that none of us would find desirable.

Mr. BACCHUS. Thank you very much, Dr. Spencer. Thank you very much, Mr. Chairman.

Mr. BROWN. Mr. Ritter?

Mr. RITTER. Thanks Mr. Chairman and I was present at a FIFRA hearing in my other subcommittee in which I serve as ranking member which is a Federal Insecticide Fungicide and Rodenticide Act. I did it.

I'm kind of curious listening to you, Dr. Rodgers, and the others and thinking about a bill that we just passed in the NIST Authorization, we passed in the House an amendment that would grant

$100 million dollars to NIST to parcel out to worthy high risk, high technology ventures. In looking at your testimony, Dr. Rodgers, you would like to kind of fix the financial infrastructure rather than, I take it, provide a Federal fix through a bureaucratic infrastructure? And I couldn't agree with you more.

But I'd like to get your—the various individuals here at the table—I'd like to get your thoughts on specifically the idea of the National Institute of Standards and Technology being the overseer of a $100 million high risk, high tech loan fund. And quickly, Larry, do you want to start off?

Dr. SUMNEY. I think that the Nation has to recognize that its economic security is just as important as the defense security and having the Department of Commerce and NIST more tightly coupled to recognizing the importance of the semiconductor industry, high technology industries through the funding of the Advanced Technology Program, is a step in the right direction.

Mr. RITTER. I'm sorry, you didn't answer my question.

Dr. SUMNEY. Okay.

Mr. RITTER. I asked you not about the funding of the Advanced Technology Program, I asked you about a $100 million dollar high tech, high risk loan fund to be given to NIST to get into the business of, I guess, of reducing the cost of capital for many American companies that face the bind that everybody here talks about.

Mr. BROWN. This in addition to the other—

Mr. RITTER. In addition to the $37 or $40 million in NIST, there is a 100 million loan fund and I'd like to get your impression of that.

Dr. SUMNEY. Again I think the answer is still appropriate. I think getting the Department of Commerce more tightly coupled to these issues is a very important step in the right direction. I would support it.

Dr. RODGERS. I think the loan fund in a lot of ways is like Sematech and other granting organizations that are trying to fill a gap that's in our financial system caused by Glass- Steagall and the fact that our banks can't lend into this middle ground where you need a lot of money and the rate of return isn't good enough for venture capitalist but, Congressman Ritter, I believe that it is going to be a can of worms. Project yourself forward—first of all, it's not enough money to make a big difference, secondly you are going to make a highly visible picking of a winner and the losers will all complain and we'll get sucked into that debate. What we really need is to create an infrastructure so that the hidden hand in the free market takes care of all that and it doesn't need to be managed. Because it's too complicated to manage.

Mr. RITTER. Dr. Spencer?

Dr. SPENCER. It would be wonderful if we had a global free market rather than our's being free and everybody else's being expensive or closed or whatever.

I think Dr. Rodgers has made some good points. Mr. Pickle, this morning, made what I think is the operative point —

Mr. RITTER. I'm talking about the $100 million fund—

Dr. SPENCER. I understand that and Mr. Pickle I think made a point this morning that I think pertains to that. I believe we need a national technological policy in that area. And then decide

whether this sort of fund fits under that policy or not. What we're doing is providing Band-aids in a lot of areas and running a number of experiments that I think we've been down before and we know the problems in it. So I —

Mr. RITTER. It sounds like you're saying it's a lousy policy but in the—

Dr. SPENCER. No, I think it's no policy. I don't think we have a policy and I believe that is an important role for your committee here is to look at that policy—

Mr. RITTER. So in the absence of any investment policy that works for our competitive industry, you would support this $100 million—

Dr. SPENCER. I would support it and that's a fairly small amount compared to what our competition is doing and until we get a policy, I think we need to run those experiments.

Mr. RITTER. Do you think NIST people are going to be, by the way, able to handle the investment banking and venture capital capacity necessary?

Dr. SPENCER. I think that's a good question. I don't know the people in NIST well enough to answer that. I think they're mostly scientists and engineers.

Mr. RITTER. You've answered my question.

Yes, Dr. Rogers—Dr. Rogers, we've got that—

Dr. ROGERS. That was quite an interesting proposition. Should the U.S. Government get into the venture capital business with a small $100 million fund, and I think not. I think that with the right financial structure, tax laws as Dr. Rodgers has pointed out, I think that you are going to get a lot of additional people interested in venture capital—

Mr. RITTER. We can't change tax laws around here. Federal Democrats say that capital acquired through various and sundry capital gains mechanisms is tax breaks for the rich. So we can't do that—politically we're not able to do it although, I tell you, in talking privately with a lot of my liberal Democrat friends, particularly those who have districts that are inclined towards making things and competing in the global economy, they're all for it and especially a sliding scale.

I think we have consensus right now—intellectual and substantive consensus right now—on a sliding scale capital gains tax where the capital gains exclusion gets larger over time and becomes zero. I have a bill like that which we put in a month ago, Tom Campbell has a bill like that, Jake Pickle supports it. I mean, the support is there in the Congress and we can't get a bill like this even though the taking away of the capital gains differential has actually dried up venture capital, and reduced growth and probably reduced tax revenue collection, and probably leading to this yawning of the deficit that we face now.

Dr. ROGERS. I agree with you, I support it. We need to work together and—

Mr. RITTER. Dr. Nishi?

Dr. NISHI. I'm sorry, I'm not aware of this thing, therefore I have no comment.

Mr. RITTER. Would you support a $100 million fund established for the National Institute of Standards and Technology as a kind of

sinking fund in the absence of available capital? Would you support a Government-run venture capital fund such as that for high risk industry? You are now aware.

Dr. NISHI. Thank you very much.

Mr. BROWN. He passes.

Dr. NISHI. I really think that I need to digest the things more precisely.

Mr. RITTER. Good, good. Let me just say that I would like just a quick yes or no comment.

I produced a bill a couple of weeks ago, the Chairman of this Full Committee, and the Ranking Member of this Full Committee, the two Co-chairman of the Competitiveness Caucus have co-sponsored, the ranking Republican on the Joint Economic Committee has co-sponsored this, and a variety of Ways and Means competitiveness-oriented and interested-in-global-competition members have supported this as original co-sponsors. It is to do away with the quarterly report, that is,the requirement for the quarterly report.

I get a rundown here?

Dr. SUMNEY. I would support that. I--T.J.'s testimony focused on this very thing that all the attention goes on the quarterly report and everyone forgets the long term.

Mr. RITTER. By the way, Wall Street dealers and brokers don't like it because it—

Yes, T.J.?

Dr. RODGERS. I think we need to do away with the financial communities focus on quarterly results, which can be achieved. I'm very skeptical of turning lose some of our companies for an entire year and seeing how it worked out.

Mr. RITTER. I'm sorry, so what is your—

Dr. RODGERS. So you'd have a—

Mr. RITTER.—both sides of the fence—

Dr. RODGERS.—capital gains tax which forced people to think in the long term, 100 percent exclusion after three years but you still report quarterly.

Dr. SPENCER. It's a good idea.

Dr. ROGERS. I think that timely reports to stockholders are important to keep them involved and understanding what's going on in the company. I think that Dr. Rodgers has the right idea in terms of, unfortunately again, a change in the tax structure so that—

Mr. RITTER. Of course we're the only industrial country that has a quarterly report and you know, for so many years we've heard about the quarterly report syndrome. We understand it's caused by underlying factors, and what have you, but you know it is a depression era innovation and it may not be relevant today, it may be obsolete and it may be focussing our concerned parties on the wrong ball. In other words, you do a lot of things. You can, you know, scale back your employees or cut this cost in order to look good every quarter but we know what happens on a quarterly basis, not that much. Especially as we try to deal with a longer term set of circumstances.

Dr. Nishi?

Dr. NISHI. If this can really help to cultivate a longer term kind of mentality of our thinking or doing the business, then I would support it.

Mr. RITTER. I think it's symbolic of trying to cultivate that. We understand that there are far reaching, underlying factors that are more important.

Okay. Mr. Chairman, with that I yield back.

Mr. BROWN. Thank you very much, Mr. Ritter. We appreciate the fact that you left another committee to come over here and, of course, we always appreciate your contribution.

Gentleman, just to sort of bring this to a conclusion, let me reiterate what we are trying to do.

We are faced with a situation where we have moved down the path toward utilizing consortia developed in different ways, structured in different ways, in the semiconductor industry, hoping to solve some of our problems and recognizing the importance of that industry. However, semiconductors, as we all know, are only one of a couple of dozen significant high technologies in which we face problems. And what we are really looking at is the broader question of how can we use the experience of the semiconductor industry with consortia to develop a national strategy or pattern that will allow us to do this better?

We have some contrasting points of view here. Two of you represent consortia which are organized differently, structured differently, have slightly different views of what your goals are. Two of you represent smaller firms which have some serious problems with consortia and think that this may not be the answer to all of our problems. Dr. Nishi has a unique perspective on both the U.S. and Japanese method, and from him I have gained the perspective that even in Japan the consortia went through a process of evolution and development, which led to their more effective contribution to the goals of Japan.

Now, what have we learned here? Dr. Spencer, you are going through a process of analyzing Sematech's role for the future. What do you think is the direction of that evolution?

Dr. SPENCER. We've just put together a series of a dozen and half of what we think are the key lessons from that, and I have them in my briefcase. We are getting ready to use them as we make a submission to DOD for funding in 1993, and I think we should supply those to you.

Mr. BROWN. I would appreciate it if you would at a time that is convenient for you.

Dr. SPENCER. Well, I think we could do that in a couple of weeks, three weeks, I think they will become fairly public. But we feel that one of the key lessons is that we're going to have to have a broad constituency for this. And it's one of the reasons—the point that Ms. Horn raised—of our looking at the membership in Sematech. I think one of our most successful endeavors has been the partnering between vertically between organizations, as well as horizontally, those things in the few months that I have been there. I have watched meetings take place in manufacturing management or competitive analysis, the sharing of information that is picked up from Japan or Europe, that I didn't believe were possible before I went down there, and I think those are things that we

have learned. I think we need a cross section in Sematech of small and large companies, I believe it's diversification in the United States that's part of our strength.

I happen to believe that we can't allow the dinosaurs to die. If you remember the dinosaurs supposedly disappeared because we had a meteor impact—now the guess is somewhere down the Yucatan Peninsula—and we can't allow that meteor today to be foreign competition and do away with the dinosaurs to adapt to this new environment. Those are the things, and finally, I guess if I—one lesson from this, in the points you just made, is that consortia didn't start in Japan last year, or last decade. In fact from what I can learn, the Japanese learned about consortia by going to Europe in between the two World Wars and looking at what England had done and attempt to bring their capability—the things they learned in the First World War where they had shortages—back up to world standards. And shortly after the war a group of Japanese visited those organizations and the cooperation between Government and industry started in Japan.

So I think we have to be patient, we can't expect to solve all of our problems this year, or even this decade, but I think there has to be a real urgency in getting started on those.

Mr. BROWN. Dr. Sumney, you, in making the case for consortia, indicated that they used resources more efficiently and addressed shared problems among the consortia members, reduced duplication in R&D, and speeded development process development and transfer of technology. You're organized somewhat differently from Sematech, presumably the way in which you have organized helps to achieve some of these things more effectively, is that right?

Dr. SUMNEY. That's correct. We encourage a broad spectrum of companies in our fee structure, ranging from companies with even no sales who can join the SRC for $500 and have access to a $31 million research program to the very largest companies that belong. And the reason behind that is that if we are going to integrate the needs of the semiconductor industry, we have to have a broad constituency to get our input from. We have to look at the input across the entire industry.

So for that reason we encourage all companies to join. As a matter of fact we just changed our fee assessment in June to encourage fabless semiconductor companies to join the SRC and, recognizing many of the things that have been said here this morning, that they are an important part of the semiconductor industry.

Mr. BROWN. Of course broadening your scope to be all encompassing brings about a whole new set of problems, so effectively organizing these—

Dr. SUMNEY. That's the value added of the SRC, however. We can bring these companies together through various committee structures and through the value add that we bring to it we hope to be able to integrate the needs to those that are precompetitive and generic and are shared by all of them.

Mr. BROWN. Dr. Spencer, in looking at the future of Sematech, have you thought about a model that would not be so all encompassing but would, say, encourage the dozen or so major members to network with smaller members in the fashion that we try and encourage manufacturers to do. And the Malcolm Baldrige Awards

where they look to their suppliers and help them to improve the quality of what their doing.

Dr. SPENCER. Mr. Brown, I think you put your finger on the key point and that is, what is a good size for something. And certainly you are right if there were keeping 14 board members and the Federal Government happy, as a consortia manager, is quite a juggling act and I'm not looking forward to having 10 more board members, each raising their own parochial concerns.

I believe the—and I'm glad you brought up the quality point—I believe one of the major things, and perhaps the major thing that will come out of Sematech is in changing the way that companies work together. We started about a year and a half ago a program which we call "partnering for total quality" and all of the companies, from the very smallest to the largest in Sematech, will give us kudos for that. I don't know any other program that we've got that's got that sort of universal agreement. But it is looking at the way companies can work together.

And I think the examples—this is a place where we can learn from what our competition has done particularly in the Pacific Rim. I think their partnering has been taken to a higher level than we have traditionally done in the United States. That generally means that there are smaller numbers of suppliers to any particular company but that those suppliers and the company have very close relationships. They work together to solve mutual problems, they don't go into divorce court the first time there is a little problem.

Mr. BROWN. But Dr. Rodgers has properly pointed out and Demming's been preaching the same gospel that this is stupid management that caused us to let our quality to deteriorate and smart management will build it up without consortia. That was your statement, wasn't it, Dr. Rodgers?

Dr. RODGERS. Right.

Mr. BROWN. That's what Demming's saying too.

Dr. SPENCER. I believe that smart management can turn that around. I don't think though that's going to solve every problem that we have because we've got a quality program at each of our companies— we've changed the way we work with our suppliers— is going to be the only solution to our problems. Someone made the point earlier that the cost of R&D in this area today is so great that it is hard for any single company to fund that.

Mr. BROWN. Dr. Sumney, you stated that it's important that we're competing with countries that are involved in—I think your statement says industrial and technology policy to aid their high tech industry—and we're still struggling over just what it means to support technology policy and we certainly eschew industrial policy of any kind. Frankly, I can't ever tell the difference.

I think what we really need is leadership and I think you indicated that that was a proper role for Government, Dr. Rodgers, which can conceptualize the trouble that we're in and begin to provide some leadership, and if they cut across many different lines aimed at solving those problems which are causing us to lose market shares and which will present a true picture of whether we are or not.

Obviously, we don't really understand what our situation is when we don't understand the relationship of, say, the value of the dollar on the balance of trade. If we're not looking at that properly, we're going to come to the wrong conclusions about how serious the problem is.

Well, I'm afraid that we are going to have to close this very interesting hearing, and let me express my appreciation again to all of you for your very helpful contribution and, Dr. Spencer, if you could help us with that additional material that you mentioned, in a timely way we'd appreciate that.

Dr. SPENCER. We'll get it to you right away.

Mr. BROWN. All right. Let me also indicate that Mrs. Morella has a statement which I'd like to include in the record, without objection, and any other members who wish written statements for the record may do so.

Gentlemen, you are excused and the subcommittee will come to a close.

[Whereupon, at 12:10 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

[The prepared statements of Mrs. Morella, and Messrs. Roemer and Ritter, plus Appendix follow:]

CONSTANCE A. MORELLA

SST/T&C SUBCOMMITTEE HEARING

SEMICONDUCTORS: THE ROLE

OF CONSORTIA

JULY 23, 1991

MR. CHAIRMAN, I AM PLEASED TO WELCOME OUR SPECIAL GUEST WITNESS, CONGRESSMAN PICKLE, OUR DISTINGUISHED COLLEAGUE FROM AUSTIN, TEXAS, TO OUR SUCOMMITTEE. I AM LOOKING FORWARD TO HEARING HIS VIEWS ON THE USE OF CONSORTIA, SUCH AS THE MICROELECTRONICS AND COMPUTER TECHNOLOGY CORPORATION (MCC) AND SEMATECH AS MODELS FOR FUTURE RESEARCH AND DEVELOPMENT.

LATER TODAY, I WILL HAVE THE PRIVILEGE OF INTRODUCING DR. WILLIAM PHILLIPS, CHAIRMAN OF THE NATIONAL CRITICAL TECHNOLOGIES PANEL AT A HIGH TECHNOLOGIES LUNCHEON IN MY DISTRICT. RECENTLY, DR. PHILLIPS' PANEL LISTED SEMICONDUCTORS AS ONE OF OUR VITAL "CRITICAL TECHNOLOGIES" AND CONCLUDED THAT SEMICONDUCTORS WILL SERVE AS ONE OF THE FOUNDATIONS OF OUR NATION'S MANUFACTURING BASE.

AS WE ALL KNOW, SEMATECH, THE GOVERNMENT-CREATED SEMICONDUCTOR CONSORTIA, WAS CREATED IN 1987, FOR A PERIOD OF FIVE YEARS, AS A NON-PROFIT RESEARCH AND DEVELOPMENT PARTNERSHIP BETWEEN INDUSTRY AND THE DEFENSE DEPARTMENT. AS WE ARE REACHING THE CLOSE OF SEMATECH'S FIVE-YEAR AUTHORIZATION, WE MUST EXAMINE THE MERITS OF EXTENDING SEMATECH'S AUTHORIZATION AND THE VITALITY OF REPLICATING THE STRUCTURE OF SEMATECH IN OTHER RESEARCH AND DEVELOPMENT AREAS. WITH THE SUCCESS OF SEMATECH AS OUR GUIDE AND MODEL, SHOULD WE CREATE CONSORTIA TO FURTHER OUR INTERNATIONAL COMPETITIVENESS IN OTHER CRITICAL TECHNOLOGIES?

THIS ISSUE, ALONG WITH THE ROLE OF THE FEDERAL GOVERNMENT AND THE FUTURE INTERNATIONAL COMPETITIVENESS OF THE UNITED STATES SEMICONDUCTOR INDUSTRY, ARE ISSUES WHICH I AM PLEASED OUR WITNESSES WILL BE DISCUSSING THIS MORNING. I LOOK FORWARD TO AN ENLIGHTENING DISCUSSION.

THANK YOU, MR. CHAIRMAN.

Opening Statement, Rep. Tim Roemer, Subcommittee on Technology and Competitiveness, July 23, 1991

I would first like to commend the Chair of this Committee, Mr. Valentine, and the ranking minority Member, Mr. Lewis, for their dedication to reclaiming Semiconductors as an American Industry. I would especially like to recognize the leadership of the full Committee Chairman, Mr. Brown, whose presence here today is a clear statement of how important this hearing is, and of how important this industry is to our country.

Mr. Chairman, in little over a decade, the United States has gone from being the undisputed leader in the semiconductor industry to suffering a $600 million dollar trade deficit in this area with Japan.

It is imperative that we regain our advantage in the semiconductor business. The United States enjoys a superior Research and Development community, and we must explore better ways to translate this work into commercial viability. No where is this more blatantly obvious than in the capital-intensive semiconductor industry.

Our ability to compete will have a direct impact on our defense systems, our computer manufacturing base, and our telecommunications industries, some of the most important business this country conducts.

Today we will explore the feasibility of consortia as a remedy to recapturing the American edge in this vital segment of our society's business and science worlds. I look forward to the debate and discoveries we will make in this hearing.

OPENING STATEMENT
HEARING ON
SEMICONDUCTORS
HON. DON RITTER (R-PA)
JULY 23, 1991

Thank you, Mr. Chairman.

Semiconductors are the foundation technology of the electronics revolution.

Because these devices are widely applied in the processes and products of a broad array of industries, a healthy semiconductor industry is essential to the continued economic viability of industries ranging from computers to telecommunications to advanced machine tools.

Indeed, the pervasive role that semiconductors play in our economy makes them indispensable to our national security.

In the late 1980s, the growing market share losses suffered by U.S. producers in this strategic industry led to considerable debate about how to restore U.S. competitiveness.

Out of that debate eventually emerged a proposal to create Sematech, a government-industry consortia that would enable the best minds in the semiconductor business to work together on developing technology that could give U.S. producers a competitive advantage.

I welcome this morning's hearing to review the success of Sematech in meeting its originally intended objectives in this critical building block technology.

Today's hearing will also provide an opportunity to discuss the merits and disadvantages of possible future Government involvement in other consortia--especially in those that go beyond R&D and allow joint production.

I'd like to welcome our distinguished witnesses and look forward to their testimony.

Thank you.

APPENDIX

Campaign for Responsible Technology

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Congressman Tim Valentine, Chair
Sub-Committee on Science and Competitiveness
1510 Longworth Building
Washington, DC 20515

August 1, 1991

Dear Congressman Valentine,

Enclosed are a number of submissions by the Campaign for Responsible Technology for inclusion in the official record of your July 23, 1991 hearing on Semiconductors: The Role of Consortia.

The Campaign for Responsible Technology (CRT) unites diverse organizations to promote broader participation in the design and development of new technologies. In our experience, rapid technological change has led to many adverse social, political and economic impacts.

We envision a world where technology better serves social and environmental needs, and empowers communities and workers. For this vision to become a reality, vastly increased citizen participation will be required to ensure the responsible development and implementation of new technologies.

CRT seeks to strengthen locally based organizing and help provide a larger national context for groups that are dealing with technology-related issues. CRT is building a national network of grass-roots organizations who recognize that many diverse, but related problems can only be overcome by extending democracy into the technological decision making process.

In short, CRT seeks increased democratic control over the design and implementation of technological innovation.

Many high tech business leaders--and some politicians--are calling for government intervention to create industry-led, business-government partnerships to help improve America's high tech competitiveness.

Thus far, our campaign has focused on SEMATECH as the leading example of such partnerships. SEMATECH's defined mission is to build a smaller, faster micro-chip to challenge the growing success of the industry's Japanese-owned competitors. However, as a government-sponsored agency with a $100 million annual

taxpayer subsidy, Sematech must be held accountable to the needs of workers and communities. It's mission must reflect social goals--not just a private business agenda.

The Campaign for Responsible Technology (CRT) seeks to redefine Sematech's role as a major agency of industrial policy. We believe that SEMATECH can make a significant contribution helping to solve important economic, environmental and health problems facing electronics workers and their communities. I've enclosed a background paper SEMATECH, Toxics and U.S. Industrial Policy we prepared elaborating this position.

On May 17, 1991, nineteen representatives of environmental, community and labor organizations met with SEMATECH to discuss these concerns. We presented a number of concrete proposals for work that the SEMATECH could do to specifically address our problems. Enclosed is a letter to SEMATECH detailing the proposals.

A short article and photo about our meeting with SEMATECH in the Austin American Statesman did a nice job summarizing our position and the exciting possibilities we see for consortia to play a vital role in our efforts to resolve problems facing high tech workers and their communities.

I hope you'll be able to include all of these materials in the official record of your hearing. If you should have any further questions about CRT or our perspective on research and development consortia like SEMATECH please don't hesitate to contact CRT Chair Ted Smith or me at the above addresses and phone numbers.

Sincerely,

Rand Wilson

BUSINESS

Saturday, May 18, 1991 Austin American-Statesman

Staff photo by David Kennedy

Ted Smith, center, executive director of Silicon Valley Toxics Coalition, meets with reporters Friday after talking to Sematech officials about environmental, safety and hiring concerns. With him are Rand Wilson and Susana Almanza of the Campaign for Responsible Technology. Sematech agreed to talk with Montopolis community leaders about creating a policy that addresses these issues.

Striving to be a 'good neighbor'

By Kirk Ladendorf
American-Statesman Staff

Sematech agrees with activists to address labor and environmental issues

Officials at Sematech met Friday with a group of environmental, labor and community activists who hailed the get-together as the start of a new dialogue on social issues between the high-tech industry and social groups.

Activists said Sematech agreed to talk with Montopolis community leaders on the creation of a "good neighbor policy" that would include minority hiring, environmental and worker safety issues.

Austin community organizer Susana Almanza said her group, the Campaign for Responsible Technology, wants more information on Sematech's hiring of minority workers. A survey of the Montopolis neighborhood, she said, showed only one person who knew someone working at the consortium.

Ted Smith, director of the Silicon Valley Toxics Coalition, called the meeting "a good first step" toward reducing the use of toxic materials in chip manufacturing.

"We see that Sematech is uniquely situated to develop the next generation of safe technology," Smith said, adding he would like to see the chip industry move away from using any toxic materials.

"Sematech is in a position to develop technologies that are not continuing us on that toxic treadmill," he said. "They've already made some progress and we think there's a lot more progress that can be made."

Consortium officials said they met with the activist group, gave them a tour of Sematech, provided them with information about its operations and agreed to give a written response to detailed questions.

Sematech spokesman Miller Bonner said the consortium is gradually reducing the dependence on some toxic materials through helping to develop a new generation of chip-making equipment.

For example, he said, Sematech worked with Eaton Corp. to develop new ion implant equipment that uses solid arsenic rather than much more toxic arsene gas.

It is also insisting on more safety features in equipment and on stringent training for handling of toxic materials.

Bonner said some of the group's requests, including more meetings with Montopolis area residents, will be easy to meet. Others will be more difficult.

Sematech, he said, does not dictate policy to its members on environmental issues or anything else. Its function is to help its members regain the world's lead in chip-making technology.

SEMATECH, TOXICS AND US INDUSTRIAL POLICY

Why We Are Concerned.

By Lenny Siegel, Ted Smith and Rand Wilson [1]

Introduction

Dramatic changes in Eastern Europe have initiated the global warming of the cold war. These changes present an opportunity to redefine national and global security in terms of domestic needs rather than continued cold war political posturing. With economic, social and environmental problems in the US requiring immediate attention, a real debate about US industrial policy for the 90s is emerging.

At the same time, the US high technology manufacturing sector is being buffeted by fierce global economic competition. Business leaders are demanding relief, but Bush administration ideologues are opposed to any government intervention. Meanwhile, citizens and workers affected by high tech industrial development are crying out for help with significant environmental and occupational health problems.

Within this context, the movement to combat toxics has emerged as one of the most energetic and potentially powerful social forces of the 90s. Following in the footsteps of earlier labor, civil rights, peace, and women's movements, the grass-roots environmental movement is galvanizing the American people to develop pollution prevention strategies that require the development of clean technologies. As a social movement, we are challenging fundamental conceptions about the organization of production and consumption in our economy.

All of these threads--the thawing of the cold war, the emerging debate on industrial policy, the increase in global high tech competition, and the growing demand for toxics use reduction intersect at Sematech--a high tech industry/Pentagon research consortium. For business leaders, Sematech holds the promise of cooperative high tech innovation and the key to "competitiveness." For environmental advocates, Sematech may provide a model for developing long-term solutions to eliminate high tech hazards. What role should Sematech play in the industrial policy debate?

What is Sematech?

Sematech is a non-profit consortium of 14 U.S.-owned semiconductor manufacturers, based in Austin, Texas. Half of its annual budget comes from member companies. The other half is paid in by the Department of Defense through the Defense Advanced Research Projects Agency (DARPA). [2]

The leaders of the U.S.-owned semiconductor industry formed Sematech in March 1987 to challenge the growing success of their Japanese-owned competitors. Though American-based firms retained their technological edge in chip design, Japan-based companies perfected techniques for the efficient, reliable fabrication of state-of-the-art integrated circuits.

Superior Japanese manufacturing technology had catapulted Japanese-based firms to dominance in the world market, especially for dynamic random access memory (DRAM) chips that are common in computers and mass-marketed worldwide. Consequently, the Japanese now hold more than half the world market for semiconductors (compared to 28% in 1978). Six of the top ten merchant producers are also now Japanese. [3]

Sematech's primary goal is to develop methods and machinery for squeezing more and more circuit elements onto each flake of silicon.[4] Building circuits--and ultimately computers--which are faster and smaller is seen as one of the main goals of the high tech quest. Sematech hopes to replicate patterns featuring linewidths of only 0.50 microns by 1992, and 0.35 microns by 1993-- compared to today's standard of 0.80 microns. [5]

Building smaller and faster circuits, however, requires the use of more solvents and other chemicals to achieve the necessary requirements for "clean" components. As the geometries of production decrease, more solvents are needed to wash away ever smaller "killer particles" that could jam a circuit. Smaller and faster may also mean potentially using even more toxic chemicals.

In addition to its own 500 employees, Sematech works with engineers from member companies. Through the Semiconductor Research Cooperation, it funds nine "Centers of Excellence" at U.S. universities. In cooperation with the Semiconductor Equipment Manufacturers Institute (SEMI), it sponsors the development of new chipmaking equipment at U.S.-owned companies that specialize in production equipment. [6]

Why Federal Aid For Semiconductor Manufacturers

Arguing that the international competitiveness of the American semiconductor industry is critical to the economic and military future of our country, Sematech's founders sought Federal aid. They convinced Congress to allocate $100 million per year for five years to Sematech. Among the strongest supporters of Sematech are liberal members of Congress who see this program as a giant step along the path to a comprehensive national industrial policy.

Sematech's supporters channeled the funds through DARPA because federal-level politicians believed no civilian agency could win as much political support as the Pentagon. And DARPA, particularly in the 1960s had shown itself capable of managing technologies with civilian, as well as military applications.

Tension between DARPA and member companies delayed Sematech's start-up, but over its first three years of operation, chipmakers were generally pleased with the agency's approach. In April of this year, however, Pentagon higher-ups transferred Craig Fields, head of DARPA, reportedly for his backing of programs to support civilian industry.

High Tech: A Major Pollution and Health Threat

Manufacture of computer components involves the use of many hazardous substances. The process of turning silicon into semiconductors is replete with dangerous conditions. Many serious accidents have occurred in the semiconductor industry that have resulted in industrial illness and significant environmental contamination. The industry uses toxic gases, solvents, etchants, heavy metals and volatile organic compounds that can adversely impact workers, communities and the environment. In addition, huge amounts of contaminated waste by-products are generated and must be handled and disposed of properly. Recent data from Silicon Valley reveals that the local industry disposed of more than 100,000 tons of hazardous waste off-site, and discharged over 12 million pounds of toxic waste into the environment.

The record of the microelectronics industry has been very poor. Improper handling of toxic substances in the workplace has harmed both workers and the environment. Employees of electronics firms are exposed to hazardous materials through spills, accidents, and chronic exposure that can produce severe burns, respiratory problems and immune system impairment.

Whereas much of the manufacturing and assembly takes place in "clean" rooms, these rooms are maintained to assure a particle-free product, rather than for the benefit of the workers' health. In the highly competitive field of semiconductor manufacturing, production demands too often outweigh worker safety. The result is a worker illness rate reported to the California Division of Industrial Relations that is three times that of other manufacturing industries. Likewise, an epidemiological study at Digital Equipment Corp. found a miscarriage rate among production workers that was twice as high as the "norm."

The semiconductor industry has also been a principal cause of groundwater pollution in Silicon Valley, the acknowledged "home" of the industry. Silicon Valley has 29 Federal Superfund sites--more than any other area of the US. Most were caused by improper handling of toxic solvents used by semiconductor firms. More than 150 underground chemical leaks containing more than 100 chemicals have contaminated over 200 public and private drinking water wells. In addition, Silicon Valley has more toxic gas storage and usage and is responsible for discharging more ozone destroying CFC's than any other area in the country.

How Sematech Could Help Workers and Communities

Many major semiconductor producers are now spending large sums of money on the cleanup of spills and leaks, and most are struggling to cooperate with new laws designed to reduce the risk of environmental exposure. But the structure of the industry and the short-term economic demands it faces has limited progress in the design of safer production methods.

Chip production is intensely competitive, so companies focus almost all their manufacturing technology efforts on cutting costs and increasing reliability. Few companies have the additional resources to risk on entirely new ways of doing things. In addition, most process technology is introduced or improved by even smaller, independent equipment producers. These firms may be well situated to introduce new methods, but since they don't currently pay the price of pollution or pollution-control, they have no incentive to explore alternatives.

Sematech, by bringing producers together under one roof, allows companies to share the risk of new process development. And by issuing development contracts to equipment makers, Sematech can ask for or specify pollution prevention objectives directly. For instance, the consortium could help coordinate goals and timetables for phasing-out reliance on toxic solvents, gases, glycol ethers and other hazardous production chemicals.

Sematech could also play a leading role in coordinating investment to maximize community economic stability. High tech's ability to move production as if plants and workers were pawns in a global chess game has left communities economically devastated by sudden relocation of work. Sematech could help develop economic impact

statements regarding both the longevity of manufacturing facilities and the skills needed. These Economic Impact Statments could accompany investment proposals where state or federal support was desired. Research in California has shown that the average life expectancy of a high tech facility is 6 years compared to 13 for all other manufacturing in the state.

New Directions for U.S. Industrial Policy

Electronics companies and their Congressional allies are challenging the Bush administration's hostility to civilian industrial policy. Some are even calling for a civilian counterpart to DARPA, a Commerce Department agency that would fund Sematech and other commercially oriented high-tech programs. Wharton School of Management Professor Bruce Merrifield, former Assistant Secretary of Commerce for Technology Policy, has called for such a Commerce-based agency that would fund up to 20% of the R&D costs for civilian led technological development. *

In the long run, civilian control over Sematech funding would free the consortium from the anomalies of Pentagon spending. However, funding Sematech is good industrial policy only if the consortium redesigns its research program to provide good jobs for American taxpayers and it develops technologies to reduce the risk of worker illness and environmental degradation.

More than just civilian oversight of Sematech is needed. Neighbors of semiconductor companies and representatives of the high-tech workforce should be directly involved in decision making. Only substantial citizen participation in industrial policy will lead to the economic rejuvenation that policy makers and chip manufacturers seek.

Semiconductor Bailout: The Wrong Medicine?

Lack of government support did not cause the semiconductor industry's problems. Rather, the type of subsidy and guidance that the government gives has actually contributed to the current state of affairs. Hefty US military contracts direct manufacturers towards technology that is rarely transferable to production for civilian markets.

Most military-funded high-tech projects over the last decade (as opposed to the 1960s) have been of little benefit to the commercial sector. Other military-funded programs are designed to develop chips exclusively for military use, or for short-batch chip manufacturing technology. However, Sematech is an important exception. Unlike many other military programs, up until now, DARPA has allowed Sematech to focus on commercially useful technologies.

Sematech wasn't approved because of the military importance of chips. Instead, most members of Congress thought it would help outpace Japan economically. Sematech's military significance is mostly used as an excuse by people who are reluctant to support a generalized national industrial policy and are looking for a way to consider semiconductor production an exception.

Grass-Roots Participation Needed

Sematech, if supported at all by the government, must be managed by another Federal entity. Pentagon oversight sets (or reinforces) a precedent that DOD is the best agency of industrial policy. Further, as the Pentagon is forced to cut back, pressures to tailor Sematech to other DOD research goals will undoubtedly increase. Most importantly, there is no mechanism through which citizens groups and workers can mold the objectives of Sematech. DARPA just isn't used to letting many union representatives and environmentalists sit on its advisory committees.

A more genuine effort to address the problems of the US semiconductor industry would also address the self-defeating short-term demands of the US economic structure. High interest rates for R&D and capital equipment financing have contributed more to the demise of the US chip industry than any other factor. US investors are much more impatient for high returns on their investments than their Japanese counterparts, who seem willing to accept short-term losses and wait for long-term gains. As a result, the Japanese are already way ahead in developing manufacturing technology that will dominate the 1990s.

In response to their problems, the US semiconductor industry calls for trade sanctions, increased economic protection, and exemptions from US anti-trust legislation. And, as is so typical in other US industries, the industry blames Japan for its failures. This nationalistic approach not only ignores the root causes of the industry's problems, but obscures the decidedly multi-national character of the semiconductor industry. While the US semiconductor industry is always receptive to a government handout, many firms are simultaneously in the process of cutting their own deals abroad. Many major US, Japanese, and European firms have already linked-up their businesses in joint ventures, and nearly all US-owned merchant chip makers do most of their assembly offshore.

The Campaign for Responsible Technology

The Campaign for Responsible Technology (CRT) is concerned with the environmental and health implications of the microelectronics industry and, more broadly, the role of Sematech in national high tech industrial policy. We believe that the work that Sematech is engaged in must include a strong commitment to making the research, manufacture and deployment of chip manu-

facturing technologies safer and less reliant on toxic substances.

Members of the campaign represent a broad cross-section of citizen, occupational health, environmental and labor groups concerned about these problems. We are primarily from geographic areas in the US where microelectronics research, development and production is concentrated.

We believe that Sematech is in a strategic position to help implement badly needed reforms within the semiconductor industry. We believe that Sematech should:

- develop new technologies and processes that will be less dependent on toxic chemicals;
- introduce new health and safety procedures for microelectronics workers that will reduce the industry's shocking rates of occupational illness, reproductive hazards and diseases;
- provide increased information and education to Sematech member companies concerning health and community hazards, and appropriate solutions;
- ensure that scientists, engineers, and other Sematech staff are being trained in toxic use reduction methods, and that they include occupational and environmental health factors in the design of new products and production processes;
- create an advisory board composed of labor, environmental, and health professionals to oversee Sematech's environmental and occupational health programs;
- evolve towards a funding base less dependent on the Pentagon.

Representatives from the campaign's sponsoring organizations will meet with senior Sematech managers on June 4, 1990. At this meeting, we seek to review Sematech's current policies and the organization's commitment to the health and safety of electronics workers and host communities. In addition, we will use this opportunity to have an overall discussion of Sematech's unique role in U.S. industrial policy.

For more information about the Campaign for Responsible Technology contact:

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Notes

1) Lenny Siegel is the Director of the Pacific Studies Center, editor of Global Electronics newsletter and co-author of the High Cost of High Tech. Ted Smith is Director of the Silicon Valley Toxics Coalition and chair of the Campaign for Responsible Technology. Rand Wilson is Director of the Labor Resource Center and coordinator of the Campaign for Responsible Technology.

2) The 14 member companies are AMD, AT&T, Digital Equipment, Harris, Hewlett Packard, Intel, IBM, LSI Logic, Micron, Motorola, National Semiconductor, NCR, Rockwell, Texas Instruments. These 14 member firms represent approximately 80% of US semiconductor manufacturing capacity at 67 semiconductor plant sites in the U.S. Sematech's annual budget is over $200 million dollars.

3) Merchant firms sell chips on the open market, while captive semiconductor producers, such as IBM, produce for intra-company consumption.

4) Originally, some of Sematech's founders wanted to mass produce chips for sale on the open market, but a few of the larger participants insisted that Sematech's own plant be used only to prototype technologies in small, demonstration runs. Sematech's own chips are discarded, but the technologies developed for their manufacture are supposed to be disseminated speedily to member companies.

5) A micron is a metric unit of linear measure which equals one millionth of a meter.

6) Sematech has created the Tool Application Program (TAP) and an Equipment Improvement Program (EIP) to help US equipment and materials suppliers develop new, or enhance existing, manufacturing equipment. Sematech's TAP and EIP Programs support suppliers by providing a manufacturing area within Sematech's fabrication facility as well as a team of engineering and manufacturing specialists to provide technical support and analysis.

Some of the companies that have benefited from these relationships include ATEQ Corporation, Beaverton, OR, Eaton Semiconductor Equipment Division, Beverly, MA, Union Carbide Industrial Gases, Inc. (Linde Division) Danbury, CT, Semi-Gas Systems (subsidiary of Hercules, Inc) San Jose, CA, Wilson Oxygen and Supply, Austin TX, GCA, Andover, MA, Hewlett Packard, Palo Alto, CA, NCR, Dayton, OH, ORASIS Corp., Sunnyvale, CA, Westech Systems, Inc., Phoenix, AZ, Lam Research, Fremont CA, Genus Inc., Mountain View, CA.

7) ARPA, DARPA's predecessor, funded computer science research that help make possible such commonly used breakthroughs as computer time-sharing, interactive video displays, and the mouse.

8) Ann Marie Cunningham, "Pentagon, Inc." Technology Review, January 1990

Campaign for Responsible Technology

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May 25, 1991

Mr. Peter Mills
Chief Executive Officer
SEMATECH
2706 Montopolis Drive
Austin, TX 78741

Dear Mr. Peter Mills,

Thank you for a very fruitful and educational meeting. All the members of our Campaign for Responsible Technology delegation reported that they enjoyed the meeting and are looking forward to a constructive relationship with your organization.

As you know, we have requested a written response to our recommendations and proposals for the future. In particular, I want to emphasize that we need a time-line for action on our proposals or a detailed rationale of why you can or can not comply with our major request concerning:

1. Toxics use reduction for SEMATECH and its member companies for carcinogens, reproductive toxins and neuro-toxins,
2. New health and safety education programs that are sensitive to the diversity of the semi-conductor workforce and a publicly available system for health monitoring and reporting for SEMATECH's member companies,
3. A workers' improvement program implemented with semi-SEMATECH firms similar to SEMATECH's equipment improvement programs and a program for "Economic impact statements" for future semi-conductor facility siting,
4. Developing a strategy with your member firms to shift SEMATECH's financial support from the military to other sources of government and private support,
5. New hiring and training programs for the Montopolis community, including an ethnic racial and male/female breakdown of your total workforce and the level of positions minorities hold within your firm,
6. A "Good Neighbor" plan that includes emergency planning and worst-case disaster scenarios, and
7. Adoption fo our "Bill of Rights" that would ensure CRT's oversight and participation in the implementation of all of the above.

We propose that representatives of our group meet with you during the first week of June, 1991. At that meeting we would like SEMATECH officials to present their written responses-including proposed timetables for action.

We look forward to hearing from you in the very near future.

Sincerely,

Susana Almanza

Susana Almanza
Campaign for Responsible Technology

cc: Rand Wilson, CRT
Ted Smith, CRT

SEMATECH

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September 12, 1991

The Honorable Tim Valentine
Chairman
House Subcommittee on Technology and Competitiveness
U.S. House of Representatives
B374 Rayburn Building
Washington, DC 20515

Dear Mr. Chairman:

The Subcommittee on Technology and Competitiveness has provided a useful service in examining the role of consortia as a means to enhance U.S. industrial competitiveness. I was pleased to be able to participate in the subcommittee hearing on this subject on July 23, 1991.

During the course of that hearing, one witness, Mr. T. J. Rodgers of Cypress Semiconductor Corporation, directed several criticisms at SEMATECH to which I did not have a full opportunity to respond. In order to complete the record, I would like to submit the following:

1. Mr. Rodgers alleged that, "SEMATECH's membership policies discriminate against many of the companies that are leading America's comeback."

   SEMATECH is narrowly aimed at one dimension of the decline in the competitiveness of the U.S. semiconductor industry -- restoring world class manufacturing technology. A variety of problems confront the U.S. industry, including the high cost of capital, difficult access to foreign markets, and the disappearance of domestic producers of consumer electronics; but the erosion in manufacturing technology and infrastructure has been a major contributor to the relative decline of the U.S. semiconductor industry in the 1980s.

   SEMATECH's membership policies are designed with its manufacturing mission in mind. Membership in SEMATECH is for U.S. companies that operate semiconductor fabrication facilities. Tool makers and design houses can and do benefit from SEMATECH's output, but it was never intended, nor would it be productive, that they be members of SEMATECH.

Members must be able to contribute more than money to SEMATECH. They must provide experienced production engineers to work at SEMATECH. These assignees are an essential part of SEMATECH's approach to developing manufacturing technology.

As a practical matter, companies must have a certain minimum size in order to be an effective contributor. In an industry where fabrication facilities generally cost approximately $500 million, SEMATECH's minimum annual dues of $1 million was intended as a threshold of commitment and participation. This threshold ensures that members are serious and willing to contribute in a significant way.

At the other end, there is a ceiling on dues. A single member's dues can be no more than 15 percent of the total dues payments by all members. The rationale for this limitation was to protect the smaller members by ensuring that no company or companies could dominate the consortium, dictate its technical direction and overwhelm the work by virtue of a disproportionate number of assignees.

We know of no instance where a U.S. company engaged in a manufacture of semiconductors wanted to join SEMATECH but could not afford to do so. Should such an instance occur, I believe SEMATECH has the flexibility and the determination to work out a mutually satisfactory solution.

In short, SEMATECH would encourage any U.S. semiconductor manufacturer to join as a member, regardless of its size.

At the hearing, Mr. Jerry Rogers of Cyrix testified that SEMATECH had not done much to help his small semiconductor company. This should not be surprising since Cyrix itself is not engaged in the manufacture of semiconductors. Instead it designs microprocessors and then turns these designs over to foreign foundries for manufacture.

At most, Cyrix can become an indirect beneficiary of SEMATECH. Through its accomplishments, SEMATECH can provide the technology for U.S. manufacturers to successfully compete for the opportunity to manufacture Cyrix' products. This will benefit Cyrix in that its products will be made better and more efficiently. It will benefit the U.S. industry and the nation by keeping significant revenue, employment and value-added in the United States.

In this way SEMATECH is helping all semiconductor companies who are leading America's comeback.

2. Mr. T. J. Rodgers alleged that, "SEMATECH policy harms its nonmembers - even American nonmembers."

Mr. Rodgers tries to explain the harm he believes SEMATECH is causing nonmembers by pointing to a so-called "hold-back restriction" on SEMATECH-developed manufacturing equipment.

It is true that some SEMATECH equipment development contracts establish a date before which, without permission, the U.S. supplier can sell equipment developed with SEMATECH only to SEMATECH members. To our knowledge, this restriction has never deprived a U.S. equipment supplier of an equipment sale. SEMATECH's objective is to strengthen the U.S. equipment manufacturers and to make their equipment preeminent worldwide. This means encouraging them to sell to U.S. as well as foreign producers.

There is, however, a compelling justification for a minimum exclusivity period during which the SEMATECH-developed equipment is available only to SEMATECH members. The purpose is not to hold-back the equipment but merely to provide for a right of first purchase priority to SEMATECH members. These, after all, are the companies who have put up substantial sums of their own money to fund the development, assisted in the development work and borne the risk of the undertaking. As such, they have a legitimate claim to be able to purchase the first product available for sale. Were this not so, SEMATECH would surely have difficulty attracting and holding members. And without members, there would be no SEMATECH.

It is SEMATECH's policy that any exclusivity period imposed upon an equipment supplier last no longer than is reasonable to accommodate this right of first priority purchase for members. This avoids any artificial delay and assures that U.S. industry at large can have prompt and full access to SEMATECH developments.

3. Mr. Rodgers alleged that, "SEMATECH uses kick-back agreements to reduce the financial contributions of its members -- and again tilts the playing field against successful U.S. rivals."

"Kick-backs" is a startling way to characterize certain contract research undertaken by SEMATECH. The word bears no relationship to the reality at SEMATECH.

Out of more than 50 joint development contracts and equipment improvement programs currently under way at SEMATECH, only three are with SEMATECH members. Each member was selected because it possessed a distinctive expertise for the task at hand and was judged by SEMATECH officials as the most capable of achieving the desired results. These members, just like any other SEMATECH contractor, must perform the work that is derived from SEMATECH's annual operating plan and will be held accountable for its performance by SEMATECH.

Similarly, SEMATECH has entered into contracts with its members to act as a test and demonstration site for certain newly-developed or improved equipment where it is impractical or too expensive for SEMATECH to do the testing itself. In these arrangements, member companies must conduct appropriate tests, maintain special data and provide access to SEMATECH and member company engineers.

All of these contractual arrangements with members are an integral part of SEMATECH's mission. They are open to competition. No member company gains any reduction in its dues as a result of these arrangements. All members, as well as U.S. industry benefit from the results of these efforts.

SEMATECH's mission is to enhance semiconductor manufacturing technology for all of U.S. industry, large or small, member or nonmember. We believe we are succeeding in that mission.

During my appearance before your subcommittee, I also promised to expand on the lessons we have learned at SEMATECH and I have enclosed that for inclusion in the hearing record.

Thank you for the opportunity to testify before your subcommittee. We look forward to working with you on these important issues. Please feel free to contact me if I can be of further assistance.

Sincerely,

W. J. Spencer
President and CEO

Enclosure

THE LESSONS OF SEMATECH

W. J. Spencer
President and CEO

Leadership in today's global markets requires competitive companies to continually learn from their own experiences and to benchmark the best processes from their competitors. SEMATECH has learned a great deal from its first three years of existence. The information gained from these early lessons is rapidly being applied to our current programs and to their directors for SEMATECH over the next few years. Some of the lessons that SEMATECH learned follow.

SEMATECH has proven that people from different companies in a fiercely competitive industry can work together if the issues are properly defined. To enlist effective member collaboration, SEMATECH must continue to concentrate on generic, precompetitive technologies that are of common interest to the member companies and DOD. SEMATECH's focus on generic technologies also frees member company resources to concentrate on those issues that distinguish their products from others.

SEMATECH is a horizontal consortium in that common interests among competing firms are being served despite diversity among members (differing size, market segments, etc.). SEMATECH also is effectively a vertical consortium in that it is teaming suppliers and their customers. This has been handled within SEMATECH by close affiliation with a supplier consortium, SEMI/SEMATECH.

In SEMATECH, it has become obvious that fostering an environment for open communications and nurturing horizontal and vertical activities will continue to be important. However, we have also learned that bad news travels faster than good, especially regarding supplier performance and member company benefits.

SEMATECH has demonstrated that programs must be focused to achieve success. The criticality of the supply infrastructure and the limits of available resources forced some narrowing of the original scope of SEMATECH.

SEMATECH must cooperate with other organizations. Much work must be contracted out to equipment and materials firms, to member companies, and to universities and national laboratories. Experience has shown that these external efforts often result in resources above the funded amount being contributed by the contractor, thus increasing the leverage of investments in SEMATECH.

As SEMATECH has matured, we have realized that improvements in technology transfer are required to maximize total benefit. Technology transfer must go beyond publication of reports to the establishment of ownership of the technologies and tools by key personnel at the member companies. Technology transfer starts with early member company involvement in new programs and does not end until these companies are successfully using the results. The best mechanisms are use of assignees and direct member company involvement in the programs.

One of the SEMATECH lessons was that manufacturing leadership will be difficult to obtain by merely following technology in other regions. The semiconductor industry must continue to improve its manufacturing processes and equipment base. In addition, we must be capable of making fundamental changes in manufacturing methods and technology. The best way to predict the future is to invent it.